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The Improvement of Local Varieties of Plants.

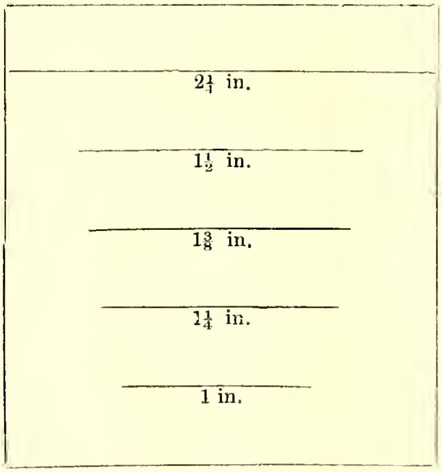
A few erroneous notions seem to be abroad again, with regard to the keeping up of the high standard of local races of plants, and it may be well to correct them. The Agricultural Society is importing many valuable kinds of seed, and people are saving the seed from these, expecting to get an equally good result in the next generation. They find they do not get this result, and they wonder why, or say it is the "Ceylon climate," though it is the simple expression of a natural law, which cannot be altered by all the agricultural societies in the world. The majority of improved races are due to continual selection of the seed, and unless this selection is carried out in every generation, or unless the Society buys good (*i.e.*, selected) seed for every generation, the result must be disappointment. Deterioration is in general about three or four times as rapid as improvement, and supposing, for instance, in cotton, beginning with a staple of $1\frac{1}{4}$ inch, we have in a hundred generations improved this length to 2 inches, it will fall away in about ten generations or less to $1\frac{1}{4}$ inch again, unless selection be practised. [These numbers are, of course, purely hypothetical.]

Improvement of races is carried on in two ways, and we must carefully distinguish between these. It may be by the continual selection of the better, in the almost infinitesimal differences which always mark any crop or character, or it may be by the picking out of absolutely new characters, which appear as what are called *sports* at long intervals; these do not go back to the race from which they sprang, but may themselves be improved by selection, and the improved race will go back again to their starting point if left alone. Thus, for instance, in the carnation, a new pink variety suddenly appears as a single, or as a very few, individuals, among a lot of red ones. This pink form may be cultivated, and its offspring, if not crossed with the reds, will remain pink for any number of generations. Mr. Lock, lately Scientific Assistant at Peradeniya, has produced an excellent race of "native" peas by crossing on scientific principles, that will not "go back," and we are now busy multiplying these with a view to putting them on the local market.

Speaking generally, these sports only appear among the offspring of crosses, *i.e.*. mainly among garden plants, and if we start to look for them in a field crop, we may be grey-headed before one appears. The improved races in field crops, be they of rice, potatoes, cotton, or what not, are practically always due to selection, and we must either practice selection ourselves to keep up the quality, or buy selected seed from elsewhere at considerable expense. Nothing in this world that is worth having, can, as a rule, be got without considerable labour or expense.

To illustrate roughly what is meant, we give here the lengths of some samples taken absolutely at random, from the best sample of cotton that has yet been sent in to my office, by anyone in Ceylon, and which is not grown from seed imported last year from the West Indies. This cotton is Sea Island; the original parents had a staple of 2¼ inches, and these plants are so far as we can find, from the third generation only from these parents, yet see the difference in the staple, the longest of these being under 1½ inches. Now in cotton, every trace of length beyond 1½ inches tells rapidly on the price, and instead of these being worth 1½-2¼ of the price of the original cotton, or about 1*s.* 2*d.* they are only worth at most about 9½*d.* In two or three more generations, the length of staple of these cottons, without selection, would have shrunk to perhaps 1¼ inches, and the price to 7½*d.*

Cottons from Third Generation of 2¼ Inch Sea Island in Ceylon.



The space between the vertical lines is 2¼ inches. The horizontal lines represent the lengths of staple found. Note also different lengths of staple.

Value of 2¼ inch Sea Island	...	1*s.* 8*d.*	per lb.
,, of the longest of these	...	9½*d.*	,,

Not only does the quality deteriorate, but it does not remain constant throughout the lot, some of the plants deteriorating faster than others. A buyer of this cotton, finding in it a large proportion of staple with the length of only one inch—that of the sample at the foot, would, of course, as every planter in Ceylon knows by experience or conversation, only give for it the price of this short staple, *i.e.*, 7*d.*, so that cotton that might, by care, have sold for 1*s.* 6*d.* will only fetch a good deal less than half that amount.

We are using cotton as an illustration, because the success of the experiments at Maha-iluppalama, and those of Dr. Fernando, with Sea Island and other cottons, is already causing signs of these cultivations being taken up, and if the standard is to be kept up to really high figures, something will have to be done, for to get selected seed every year from the West Indies will be difficult, as they have none too much for themselves, and will cost a high price. The West Indian cottons all come from one lot of seed originally, obtained from the Sea Islands of Carolina, but already the different islands show very different prices, and we see from the last market report that West Indian Sea Island cotton has sold at all prices from 1*s.* to 1*s.* 8*d.* in a very short time. Doubtless, there will be a profit to the villager in even the lowest price, but it is much better, both for himself and for the reputation of the island, that he should get the highest price, and this only means care in selec-

tion. India, time after time, has imported the best cottons from abroad, and yet she gets far the lowest price on the market, though her native cotton is the same cotton as the common American, which sells for 6*d.* against India's 3½d.

To deal in brief with the way of selecting cotton: what we mainly want are length, big yield, strength, freedom from disease and silkiness, the first two being the most important. When the cotton bolls begin to burst all over the field, we must go through it with a three inch measure, and pick out 175 bushes with the very longest staple and with over 20 bolls on a bush, and free of disease; then reject any that have not the requisite strength or silkiness, and in this way, we shall probably have about 150 bushes left, which should be marked with red rags, and have their cotton separately collected and ginned, and will give enough seed for one acre in the following year. Similar methods must be employed with rice, or any other field crop, if we mean to keep up their standard.

As a good local illustration of what may be done by selection, look at the way the Java planters, by continually improving their cinchona barks, have killed the Ceylon industry. Good Java barks now contain more than twice as much quinine as good Ceylon barks, and the seed of good varieties was sold the other day at £45 an ounce.

GUMS, RESINS, SAPS AND EXUDATIONS.

The Introduction of Castilloa Elastica to the East.

By Ivor Etherington.

While first place is given by planters in the East to the Para rubber, *Hevea brasiliensis,* the Central American rubber tree, *Castilloa elastica,* cannot be altogether ignored. In Southern India it seems to have found favour more than in Ceylon, although in the island it is doing well in the Matale and Passara districts, but does not appear to thrive at low elevations not far inland from the sea.

In the West Indies, according to reports published by the Botanical Departments of the various islands, *Castilloa* is favoured as a shade tree for cacao; and in Venezuela it has been successfully used in such mixed plantations. In Mexico, where planting is going on extensively, it is the *Castilloa* tree that is almost entirely cultivated. So that as a plantation product *Castilloa* is second favourite.

The introduction of this rubber tree to the East is an interesting and some what romantic history, rivalling the story of the introduction of the *Hevea,* which Wickham successfully accomplished after many difficulties had been overcome. The tree is indigenous to most of the countries of Central America, and in Mexico is called *ulé* by the natives. It received its botanical name after a Spanish botanist, Don Juan Del Castillo, who died in Mexico in 1795. It was due to the initiative of Sir Clements Markham in the first place that rubber was at all tried as a plantation product, and in 1870 this explorer, civil servant and botanist, "came to the conclusion that it was necessary to do for the India rubber or caoutchouc-yielding trees what had already been done with such happy results for the cinchona tree." Markham regarded India as the most suitable part of the British Empire for commencing operations in rubber planting; and a detailed report on the subject drawn up by the Curator of the Pharmaceutical Society's Museum, Mr. J. Collins, stated that the *Heveas* and *Castilloa* of America being superior to *Ficus elastica* (Rambong) these trees should be introduced to the East.

"The collection of *Castilloa* plants for introduction into India was a very difficult service, for the trees grow in wild and unhealthy forests, with no means of transport and no facilities of any kind. In Mr. Cross I found a man with all the requisite qualifications for undertaking it. He is an excellent gardener, possessed of great energy and determination, is acquainted with the language, and has had much experience in South American travelling."*

Robert Cross left England on May 2nd, 1875 and arrived at Panama on the 26th, for he was instructed to obtain his plants on the isthmus. He journeyed by canoe up the River Chagres, and in his account of his expedition mentions innumerable hardships he had to endure and obstacles to be overcome in this pioneering forest work.

"The district investigated by me and where the plants were collected," he wrote, "was reached by ascending for some distance the River Chagres and then travelling for several miles through a stately forest into the heart of the isthmus. The trees seen exceeded in height and dimensions those met with in the wooded districts of the Amazon. An undergrowth of a thorny wild pine-apple (*Bromelia*), 10 feet in height, everywhere formed extensive thickets. Large powerful snakes

* C. Markham's Peruvian Bark.

were numerous, and so audacious that they deliberately rose up to strike at any one that approached. The young rubber saplings were found growing most abundantly on the banks of cool clear running streams and little dribbling rivulets. The roots could easily be traced over the surface of the ground running down to the very margin of the water. But the tree grew also on eminences, steep declivities and varied elevations, and in such abundance that the first explorers gave the name "Caoutchouc Hill" to a height which they found crowned with a forest almost entirely composed of rubber trees. It was not seen growing anywhere on swamp or marsh land. Although the rubber districts are proverbially rainy, yet the tree was seen by me growing beside a stream on the border of a desert tract of country bounding the Gulf of Guayaquil, where only a few light showers of rain fell during the year. On both sides of the stream there was a strip of good forest, but beyond, thickets of cactaceae and low spreading legumes formed the characteristic vegetation. I mention this fact to show that the tree will probably succeed well in regularly irrigated districts, even if the atmosphere be dry and dusty. The temperature in the woods of the isthmus ranged from 75 degrees to 88 degrees Fahrenheit. Rain water, examined the moment it fell, was never found to be below 74 degrees."

After some time he came across a large rubber tree laden with unripe fruit, and he watched this for a fortnight while the seed ripened. The seed was at once packed and despatched, and then Cross turned his attention to securing young plants. These were obtained after infinite trouble, brought to the coast and embarked on the ss. "Shannon," on September 6th, 1875. Two days later the vessel ran on a reef off Jamaica. All the passengers were taken off by boats, but Cross remained on board seeing to his priceless rubber plants. H.M.S. "Dryad" came to the rescue of the "Shannon," and Cross was taken on to the warship with the plants. He arrived in England on October 2nd in the the ss. "Nile," and shortly afterwards his *Castilloa* plants were thriving in the Kew hot houses.

In 1876 the first plants arrived in Ceylon, sent out from Kew in wardian cases. These were planted at Peradeniya and Henaratgoda. At first they were increased by cuttings, but in 1881-2 seeds were produced and large numbers of young *Castilloas* were despatched to India and various parts of Ceylon.

In a letter to the Conservator of Forests, Madras, written in 1881, Cross says, "A *Castilloa* tree if carefully and judiciously tapped, with a diameter of 1½ to 2 feet, may be expected to yield about 12 lb. of rubber per annum." This seems, in the light of the present limited experience with the tree in the East, and of Mexican experience, to be greatly exaggerated for trees 54 to 72 inches in girth. But Cross was a firm believer in this species of rubber tree for cultivation in India and Ceylon.

He further says, "In India there are many districts which possess all the climatic conditions necessary for the successful cultivation of Central American rubber. In Ceylon and Southern Burmah and the Malay Peninsula, the tree is likely to thrive in all proper situations..........Of all the different rubber producing trees, the *Castilloa* should prove under cultivation the most remunerative." Although this was written by a man who knew South India and who had studied the *Para, Castilloa, and Ceara* trees in their native habitats, yet actual practice up to the present shows that for Ceylon at any rate the *Hevea* is the most suitable.

SMOKING PLANTATION RUBBER.

By Herbert Wright.

In a recent communication to the press, Messrs. Lewis and Peat point out that consignments of biscuits have arrived in London in a heated and sticky condition, and raise the query as to whether the present mode of preparing biscuits is the best. It is pointed out that Amazon-grown smoke-cured is still the standard, and has for a record of 50 years maintained its reputation for elasticity, strength and durability. One of their advisers is inclined to believe that "Ceylon and Straits biscuits and sheets are at present made too pure, too much moisture being taken out of the rubber, with the result that the elasticity and strength are reduced; such rubber, it is stated, will not keep, but inevitably becomes soft and treacly if stored for any time or subjected to pressure and a raised temperature." It is finally suggested that the plantation rubber should be smoked and made up into large balls, bottles, or cakes, as in Para. The same firm in their circular, dated December, 1905, state that "the very greatest care should be taken that all rubber is absolutely dry before being packed." Obviously, in the opinion of Messrs. Lewis and Peat, the question of how to prepare the rubber for the market is a vexed one and deserving of much experiment. I have pointed out elsewhere, how Para rubber is smoked in Brazil, and that in addition to the nuts of specified palms and branches of certain tropical trees, certain antiseptic reagents such as creosote, dilute hydrofluoric acid, and corrosive sublimate have been proved to be useful in the preparation of rubber. It has also been shown that rubber prepared from trees 30 years old may, if not properly dried become quite as "heated" or "tacky" as that from young trees. If a larger proportion of moisture is left in plantation rubber, I am of the opinion that putrefactive changes will be more apt to occur, and the use of antiseptics either by direct application to the latex or by smoking or coating the rubber will be imperative. In any case, the coating of the rubber particles or smoking the freshly-prepared rubber biscuits or sheets with any antiseptic is always an advantage as far as the keeping properties of the rubber are concerned; most of the "heating" or "tackiness" in plantation rubber is due to bacteria, which can be prevented from spreading by the use of antiseptics; if not destroyed they will lead to putrefactive changes in any rubber with which they are brought into contact. Tackiness is really a disease which in unsmoked rubber can be spread by contact, but whether it is more likely to develop on rubber from young or old trees is still a point to be determined. If the consumers will accept the plantation rubber prepared by the use of antiseptics as described, the producers will find no difficulty in meeting their requirements; in fact several Ceylon estates have, for some time past, sent their rubber to Europe in the smoked condition, but whether better average prices for large quantities have been obtained is not known to the public. A little extra labour and money would be required, and the non-smokers naturally wish to see some promise of better prices before discarding a method of preparation which has hitherto been sufficiently remunerative.

Whatever the causes predisposing Para plantation rubber to tackiness may be, I certainly believe that the absence of moisture is not one of them; the necessary bacteria cannot thrive in the absence of water or in the presence of suitable antiseptics. Too rapid drying produces a softening of rubber, but this is a change fundamentally different from tackiness.

Plantation rubber is never entirely free from moisture, and is not usually dried too rapidly; it often becomes quite tacky, and for a complete determination of the causes leading to predisposition to this undesirable change it is necessary to take into consideration, in addition to the above, a varied series of factors such as the drying of the rubber in rooms too freely lighted, the imperfect internal and superficial washing of the rubber, the age of the tree or the part from which the latex is obtained, the selection of trees of varying vigour for tapping and the variation in the percentage of objectionable ingredients in latex from trees during certain seasons or from trees tapped injudiciously.—*The India Rubber Journal.*

REPORT UPON A VISIT TO GREAT BRITAIN TO INVESTIGATE THE INDIA RUBBER INDUSTRY IN ITS RELATION TO THE GROWTH AND PREPARATION OF RAW INDIA-RUBBER IN THE MALAY PENINSULA. II.

BY P. J. BURGESS.

PREPARATION OF RAW RUBBER.

14. I have already stated I am not at present in a position to say decisively how the rubber should be best coagulated and prepared for export, but I am inclined to recommend that as little as possible in the way of acids or drugs should be added to the milk or latex. Where a washing machine is used, the milk might, I think, with advantage be allowed to coagulate by simply standing for 24 or 26 hours and allowing the natural fermentation, or souring, which takes place, to produce coagulation. This, of course, will preclude any possible additions of preservative, such as formalin or dilute ammonia, to the latex in the cups, and it will be desirable to keep the latex as concentrated as possible. This natural method is of course only possible where a washing machine is used, and it involves more time be taken in the actual coagulation process. There is among the manufacturers an objection to the use of any acid or addition of any drug at all to the rubber during coagulation, from fear that traces of it might be left in the rubber, even after washing. If there were an appreciable amount remaining, it is highly probable that it would give trouble during working and vulcanisation of the rubber by acting chemically on some of the ingredients with which the rubber is mixed and perhaps producing gases which would form blow holes in the finished goods. These bubbles and blow holes do sometimes occur after vulcanisation, and care has always to be exercised to prevent their occurrence, and anything which might lead to their formation has to be carefully avoided. Whether this objection to the use of a volatile acid in curing the rubber is really sound, can only be decided by practical experience in working with rubbers so cured, but the objection is actually held, and the fear entertained, by some of the most prominent of the rubber manufacturers in England, and the knowledge of the fact that acids have been used in the curing of plantation rubber makes the manufacturer less inclined to use crêpe or plantation washed rubber without a further re-washing in the factory. Another objection to the use of acid preservative, and the addition of any drug at all to the latex, lies in the possible action of such drug on the rubber itself. Speaking *à priori* and considering the mild character of acetic acid, and the preservative action of formalin, together with the singularly inert nature of rubber, I should not expect any harmful action whatever to occur. I have, however, seen samples of rubber made from latex to which small amounts of various aniline dyes had been added. Some of the dyes (the reds especially) had produced most marked effect, making the rubber hard and brittle, and as readily torn as thick paper. Other dyes appeared to have had little deleterious effects. This perishing of the rubber had certainly been brought about by the action of quite trifling amounts of what are regarded as harmless and inactive chemicals. I have already mentioned cases of plantation rubber perishing utterly in a few years from unknown causes. With these instances before me I feel less inclined to treat the possibillty of acetic acid or formalin causing rubber to perish as absurd or fanciful, and until the question has been experimentally investigated I should recommend that, wherever possible, the use of any chemical be avoided. The position is therefore this—some of the users of rubber object to the rubber being cured with acid, and in the absence of experimental evidence we are not justified in assuming acids, even vegetable ones such as acetic, to be harmless. To avoid using any coagulant is only practically possible where a mechanical treatment of the rubber by a washing machine is in use, and then it is a matter for consideration whether the use of acid, which has been extremely con-

venient in assisting and controlling coagulation, should be discontinued from fear that such use will produce a rubber which will not stand the test of time, and which will perhaps injure in the future the reputation of plantation grown and cured rubber.

DRYING RUBBER.

15. Until the introduction of mechanical washing of coagulated rubber and the formation of crêpe, drying had been a troublesome operation in the preparation of rubber for export. Artificial heat almost always led to the softening of the rubber, and often through inefficient control of the temperature caused it to become distinctly tacky. Crêpe rubber dried easily and well if simply hung up in a dark but airy shed, and the preparation of rubber in this form appeared to have solved the old difficulties associated with drying. There had been, however, suggestions and proposals to introduce vacuum drying on estates, and consequently I paid special attention to the modes of drying washed rubber in use in Great Britain. In a few manufactories only I found vacuum had been introduced, but the great bulk of washed rubber is still dried by hanging it up in dark warm rooms. A vacuum drying chamber is a large iron box, of from 100 to 200 cubic feet capacity, fitted inside with shallow iron trays with perforated bottoms, and heated with steam pipes. The interior is connected by an iron pipe with an exhaust pump. Wet rubber is placed in the iron trays, the doors are closed, and the temperature raised to 120 to 130 degrees F., and the pump started. The air and water vapour that are drawn out of the chamber are passed through a condensing cylinder, fitted with a glass front, and the condensed vapour is seen falling as a stream of drops of water. After two or three hours this stream of drops of water ceases, and the rubber or whatever material is being operated upon is then regarded as dry and ready for removal. Rubber dried in this way is always softened by the heating which is necessary if the drying is to be rapid, and in the opinion of manufacturers who have not adopted the process the nerve and quality of the rubber are injured, though with those who have adopted vacuum drying this is not regarded as very important, chiefly because the cause of softening is known, and it is regarded as only an anticipation of the softening which always occurs in mastication of the rubber, the next step in the process of manufacture. On the other hand, some forms of rubber—such as very soft African rubbers—cannot be dried in this way at all because the softening in their case proceeds too far. The sheets of rubber dried in this way adhere to one another when packed and stored away, this is of no importance in the factory, because the rubber is known to be clean and dry and ready for use, but if the plantation rubber were offered in the same soft and adhesive masses, objection, and serious objection. would naturally be made. It would be necessary to maintain a lower temperature in the vacuum chamber than is in common use if this softening of the rubber is to be entirely avoided, and this would seriously interfere with the efficiency of the machine. The rate of the evaporation of the water and drying of the contents depends upon the difference between the temperature of the vacuum chamber and the temperature of the condensing chamber, as well as upon the absolute temperature of the vacuum chamber. In the tropics it will not be possible to maintain the condenser below 80 deg. F., which is 20 degrees above the temperature of the condenser in England. This diminished difference, together with the necessary lowering of the temperature of the vacuum chamber itself, will seriously impair the efficiency of the vacuum drier, the only advantage of which is the rapidity of drying. Taking into consideration the further fact that plantation rubber is always inclined to be soft, I should certainly not recommend any form of drying in which artificial heat is necessary, and which involves the elaboration of machinery and increase in power in doing what, with washed rubber, can be done in a more simple, safe and natural manner.

MANUFACTURE OF RUBBER.

16. *Preliminary Processes.*—The various processes through which raw rubber passes in conversion to rubber goods were, as a whole, very freely shown to me by the British rubber manufacturers. Introductions to the leading firms from the War Office and Admiralty, who are large consumers of rubber goods, were obtained through the Colonial Office, and these, together with sundry personal and private introductions, proved to be all that was necessary, and I met with great consideration, kindness and courtesy from all with whom I came into contact. In a few cases there were special and particular processes which were guarded as trade secrets, but this tendency to secrecy was in inverse proportion to the size and importance of the works. The greatest interest was shown in plantation rubber and the prospect of a future easing of the rubber market by supplies from the East, and the manufacturers realise that there can be no antagonism between them and the planters, and appreciate the efforts being made to bring the producer and consumer into closer touch.

17. The raw rubber used is of all kinds and qualities, from clean pure fine Para to the lowest grades of African rubbers, which are sticky, black, full of wood, stones and dirt, and all possible adulterations. Fine Para is delivered in balls weighing from five or six to a hundred pounds; when cut open the mass is seen to be made up of concentric shells from $\frac{1}{8}$ to $\frac{1}{3}$ inch in thickness, the rubber is grey and wet and the successive laminae are marked by dark surfaces, showing the stages of successive smoking and accumulation of the rubber into balls. This rubber is never dry, but contains water—the amount usually being about 15 per cent., but varying from 10 to 20 per cent., and the loss of weight of fine Para in washing and drying is due to this water contained in it. In the best qualities there is little or no mechanical impurity, at most a little surface dirt and grit.

WASHING RAW RUBBER.

18. The first thing to be done is to cut these large balls open and reduce the largest masses to blocks of five to ten pounds in weight. The rubber is then softened by boiling in water, this is done to enable the washing machines to deal with the lumps.

The rubber is then broken and washed on machines which are simple in construction and action, and exactly similar in essentials to the rubber-washing machines in use in the Malay Peninsula on plantations.

Each machine consists of a pair of steel rollers with roughened faces, revolving at different speeds on horizontal axes, the faces of the rollers being in contact or slightly separated from one another. The rollers are from one to two feet in length, and usually one foot in diameter. The surfaces are roughened with grooves cut spirally, or diamond shaped, and of different angles and depths according to the nature of the work. Cold water is always playing over the surfaces of the rollers in use, and it is directed usually above the rollers on to the rubber in the hopper, but in some cases at the sides, with the object of washing the dirt away from the rubber as the rubber emerges from between the rollers. The rubber usually goes through two sets of rolls, the first two break down the big lumps and roughly sheet the rubber, the second pair of rolls is smoother and in closer contact, and the final washing and working into a fine-grain uniform sheet is performed on these. In preparing rubber for the very finest work, such as cut sheet, a third set of rollers with smooth chilled steel surfaces is used. The object of these is to crush any particles of sand or grit which might otherwise be left in the rubber and damage the knives and spoil the sheet rubber when being cut The rollers are always provided with metallic guides to keep the rubber away from

the ends of the rolls and prevent contamination with grease and oil from the bearings. There is great uniformity of pattern and general arrangement of these washing mills in all the factories, the differences are in the form of grooving and roughening of the surfaces. The rollers which produce the smoothest and most uniform sheets are those in which the grooves are nearly obliterated, and in which the surface has become rough with the natural wear of the metal; rolls in this condition would, I think, be most effective with freshly coagulated latex on an estate,

DRYING.

19. The rubber in the washed or crepe form is wet not only with surface moisture but with water held in the substance of the rubber itself. It is usually dried by hanging up the strips in dark rooms warmed to about 90° F., an operation taking about a week or ten days. In no case did I notice any artificial circulation of the air to accelerate the drying. A few manufactories have adopted vacuum drying, which I have already described and discussed. There is no sign, however, of this process ousting the older fashioned method of simple air drying.

MASTICATING RUBBER.

20. The next process through which the washed and dried rubber passes is that of mastication, during which the rubber is torn, stretched, heated, and generally kneaded about until the toughness and elasticity, so characteristic of it hitherto, are destroyed, and the rubber becomes plastic.

The masticating machine consists of two steel rollers with smooth polished faces, which revolve on horizontal axes in the same horizontal plane. The distance between the two rolls can be adjusted until they are brought into contact with one another. The rolls may be any convenient size, and are usually about 3 feet in length and 12 to 18 inches in diameter. They are hollow and heated by injected steam, and may be driven at even or differential speeds. The machine, in fact, is in many respects similar to a rubber-washing machine, but differs in the rollers being smooth and being worked hot and dry and revolving more slowly. The action on the raw rubber is curious, with the rolls separated about $\frac{1}{16}$ of an inch a mass of washed rubber is thrown upon the machine, it is squeezed into a uniform sheet which is folded over on itself by the workman, and a slab of rubber produced $\frac{1}{2}$ to $\frac{3}{4}$ of an inch thick, to be fed again into the machine.

The rubber, softened by the heat of the rolls, behaves like so much putty, accumulating on the inturning faces of the rollers, heaving and seething as it is made to flow over itself, and gradually being worked through into a thin sheet, which adheres to the more slowly moving roll, the one next the workman. As this sheet comes round, wound on the roll, the workman with a stumpy knife slices it through, and peels it off, folding it over upon itself to repeat the operation of being sucked through the roll over and over again. In its passage reports as of saloon pistols are heard, as the air imprisoned in the folds of rubber is compressed, and finally bursts through the writhing mass of distended and flowing rubber, reluctant to pass through the narrow cleft to freedom. In this torturing process the fine hard cure South American Para rubber shows its superior quality and remains tougher and harder than plantation rubber when perfectly masticated. But even with South American Para the elasticity and nerve are lost, the rubber has no spring and can be bent and torn, indented and cut, and is compliant to any shape which is impressed upon it. The colour has changed, in the case of plantation rubber from the pale yellow or brown to a dirty grey, and the whole nature of the material has undergone a metamorphosis; but what this change really consists of no one can now tell.

MIXING.

21. The masticated rubber is ready now to be mixed with the hundred and one ingredients with which it is to be compounded. The requisite amount of sulphur in fine powder is added, with zinc oxide, red lead, plumbago, asbestos, powdered pumice, recovered rubber, rubber substitutes, rubber of other grades and qualities, sulphide of antimony, lime, vermilion or any of all those substances which the knowledge and experience of the manufacturer indicate as necessary for the particular class of goods which the rubber is destined to become. This mixing is done on rollers of exactly the same type as used in masticating, but the rolls are kept cooler. The rubber is put on the machine and the ingredients sprinkled on it as it passes through the rolls, they are folded between layers of the rubber, and, after repeated working through the rollers, become thoroughly incorporated and most intimately mixed into "dough" of which each factory has many types and the precise compositions of which are the secrets of each firm. The dough thus compounded is rolled up and stored for future use.

VULCANISATION.

22. Vulcanisation is the name given to the act of combining India-rubber and sulphur chemically into a new substance. There are two methods of producing the desired result, known as the heat cure and cold cure, respectively.

(*To be Continued.*)

THE RUBBER BOOM.

Whether you explore the wilds of the Cornhill or Leadenhall neighbourhoods, or merely tour the less dangerous districts of agricultural fame in the tropics, you will find that the rubber "boom" seems to be the pivot of commercial conversation. And hearing the high talk of planters and company promoters, you will be something more than human if you are not bitten with the desire for wealth "beyond the dreams of avarice" which those who dwell in lands where the rubber tree flourishes assure themselves is well within their grasp.

A few days ago I returned from visits to Ceylon, Burmah, the Dutch Indies and British Malaya, and in the Clubs of Colombo, Rangoon, Medan and Singapore every one with a few dollars to invest proclaimed that there was "nothing like rubber." In Ceylon the interest displayed in the boom amounted to a passion; in the Federated Malay States the hotels and rest-houses were agog with option-grabbers and "experts;" and on the very day I found myself back in the old country the postman brought the prospectus of the Straits Settlements (Bertram) Rubber Company, Limited, who have acquired a considerable (and costly) concession on the hinterland of Penang. It is a world-wide boom indeed.—*India Rubber Journal.*

The Nature of the Para Rubber Tree and Latex Extraction.

BY HERBERT WRIGHT.

The second of the series of lectures on the science of rubber cultivation being delivered by Mr. Herbert Wright, Controller of the Government Experimental Station at Peradeniya, was given under the auspices of the Sabaragamuwa Planters' Association in the Wace Memorial Hall, Ratnapura, on Saturday, Aug. 25th the subject being "The Nature of the Para Rubber Tree and Latex Extraction." The interest evinced may be gauged by the fact that in this remote and widely scattered district no less than 50 people, nearly all planters, were present. Mr. Wright spoke for thirty minutes only, his special aim apparently being to stimulate discussion on very debatable questions among the planters present. The lecturer on this occasion used a blackboard a good deal and illustrated his points with sketches. Afeature of the lecture was a number of slides prepared by Mr. Wright ten years ago shown under a powerful microscope. Mr. John Hill presided, and there were present:— Mr. R. B. Hellings, G.A., Mr. G. F. Plant, D.J., Mrs. Plant, Mrs. Bartrum, Miss Laing, Messrs. P. D. G. Clark, G. M. Crabbe, B. A. Thornhill, P. S. Bridge, D. Robertson, L. F. Watkins-Baker, C. Watkins-Baker, Albert Eck, J. VanDenberg, D. J. Jayatileke, H. Molyneux-Seel, Arthur Watt, F. W. Bridge, J. Jeffery, C. F. Emerson, R. Gordon-Forbes, L. Victor Neligan, J. William Robertson S. A. Rolland, A. G. Balsillie, Harold North, W. Ferguson, P. H. Bird, C. E. Clarke, A. J. Ingram, F. Lecky Watson, G. H. Danvers Davy, H. A. Dambawinne, P. C. Phillips, John Paterson, Charles Goodbrand, William Ingram, G. W. Greenshields, H. H. Low, D. T. Gurunada, A. A. de Alwis, J. F. Martinus, D. L. Dharmawardhana, F. R. de Alwis, J. P. Jayawardene. A. H. Abeyratne, D. M. Seneviratne, E. J. Wijesinghe, and F. T. Ellawala, R.M.

The Chairman briefly introduced the lecturer.

THE LECTURE.

Mr. Wright said—Mr. Chairman, Ladies and Gentlemen, most of you will probably remember that the subjects of distance in planting and the pruning of young Para rubber trees have already been previously reviewed and discussed at Kegalla; I intend to go into other matters to-day, but I shall be only too glad to hear any questions or suggestions relative to my previous remarks, if any one in this audience desires to bring such forward after to-day's lecture. The more we discuss such points the better, since it will assist us to form definite ideas on these very debatable subjects. I know that in your districts there are small acreages of rubber in bearing, and that there is every prospect of a much larger number of trees being brought to a tappable age and size at an early date. It is therefore desirable that we should all closely study the constitution of a Para rubber tree and try to understand the nature of the parts that can be tapped; we must know exactly what we are going to do to our trees, and take into account the probable effects of the methods employed. As with most other subjects connected with rubber plants, our knowledge of the points to be discussed to-day is very limited; but we must make a start sometime in the hope that information of a reliable kind will ultimately be in our possession.

THE SCIENTIFIC STANDPOINT.

I do not deliberately wish to weary you with a dry technical discourse on the anatomy of the Para rubber tree or the physiology of its many parts, but I do think it is necessary to fully describe the constitution and formation of the channels from which the rubber liquid is obtained. Enquiries from, and interviews

with, planters of an inventive frame of mind have convinced me that still better results will accrue if a sound knowledge of the latex tubes has been obtained, and, believing as I do that the permanent and most successful modes of cultivation and latex extraction will be evolved by those in possession of such information, I am going to run the risk of boring you to-day with a few details.

WHERE DOES THE RUBBER COME FROM?

We will first consider the seeds of the Para rubber tree and see whether, in their build, there is any clue to be obtained as to the source and nature of the rubber after which we are all so eagerly searching. There are, under the microscope here, some ten years old sections showing the components of Para rubber seeds. I well remember how, in 1896, one out of every six students received one, and one only, of those precious seedlings of *Hevea brasiliensis*, which you are now distributing by the thousand to all parts of the tropical world. The sections under the microscope, though made in London some ten years ago, are still in a good state of preservation, but I must confess that had I been able to forecast events and to imagine myself before you to-day, much better sections would have been submitted to your critical scrutiny. In the sections before you can be seen the embryonic parts of your giant trees, and in them the origin of the milk tubes can be traced out in a satisfactory manner. There you can observe a mass of minute and more or less regular boxes or cells, the material from which the future latex tubes arise; running irregularly throughout that beautiful network one can discern long irregular stands of deeply-stained tissues, connected here and there with cross-bands to form a much contorted ladder-like structure—that is the laticiferous system—a system only in so far that it is irregularly connected at various points, and composed of latex cells or tubes in all their stages.

An examination under a higher power of the microscope will reveal to you how the latex tubes arise and become filled with the globules of the different substances which ultimately give you the rubber of commerce, for here and there can be seen the breaking-down of the regular cells and the production of a single tube by the disappearance of partition walls. [Blackboard demonstration followed here.] This decomposition, essential for the production of the latex tubes in Para and Ceara rubber trees, commences in the germinating seeds and continues until death, and even when the trees are to all appearances dead, they may, three years after throwing out their last leaf, still maintain the milk tubes in a good condition and yield latex of fair quality. This phenomenon adds one more to the perplexing points requiring solution, and we are left to explain why latex tubes occur in only a small number of plants, are never required by many species, and even when present appear to have no vital functions to perform, and remain turgid and full of latex when most other parts of the plant are dead. The abundance of latex in dead stumps was mentioned at Kegalla, and since then you will have read of a similar condition having been observed by Mr. Ridley at Singapore.

HOW RUBBER FORMS IN THE BARK.

The processes which you can see going on in the seedling take place in the stem-bark of mature trees in exactly the same manner. What are perfectly normal and regular cells in the bark to-day may begin to show perforations to-morrow and within a few days or a week, a system of milk tubes may arise in an area which, had it been tapped too early, would never have yielded a drop of latex. I leave it to you to frame the moral to be drawn from a study of this curious development. The formation of latex tubes from a series of single cells may be illustrated by knocking out the cross-walls of an ordinary bamboo; from a series of separate chambers a single tube with the remnants of the cross-walls may be obtained. [Blackboard demonstrations here followed.] The main points I wish to impress upon you are, first, that the

latex tubes of Para trees arise by the perforation and decomposition of ordinary cells of the bark (cortex); secondly, that the processes involved require an interval of time for their completion which the constitution of the plant determines; and lastly that in tapping operations we are dealing with a series of channels which have no very vital association with other parts of the bark.

FEEDING THE LATEX TUBES: THE CONVERSION OF MANURE INTO RUBBER.

There is one very interesting section here which reveals a condition of considerable importance, in so far that it shows contact, but not open communication of a milk tube with what is called a "vessel" of the young wood; the vessels of the wood are mainly concerned in storing the water which has been absorbed by the roots, and, if direct communication could be proved between a vessel and a latex tube, we should be very near solving the great problem of how to feed the milk tubes and make them more productive. (Demonstration). I think you will all see how, so long as the vessels holding the water, and *some* of the Colombo manure absorbed by the roots, are in contact and not in open communication with the milk tube, the direct feeding of the latter in twenty-four hours' notice will be very difficult and perhaps impossible. But if direct communication can be shown to exist our knowledge of the functions of the latex and our power to influence its accumulation may perhaps be appreciably increased. It is a point observed long before my arrival in Ceylon, but I have not yet been able to follow it up; it is not generally known, and is well worth studying by anyone who can find the time to work it out. Perhaps the first effect of very soluble manures on the composition of the latex will throw some light on the subject? Anyhow, I think records of the first and subsequent effect of manures on the latex should be recorded by all who have the opportunity to make such observations; the man who discovers the conditions under which the latex tubes may become more completely charged with the required ingredients will gain for himself a substantial reward.

LATEX TUBES DRYING UP.

Sufficient has been said to give you an idea of the nature of the origin of the latex tubes in the bark or cortex and their associations with other parts of the tree. It only remains to point out that in a well-grown tree the latex tubes run more or less vertically, up and down the stem, and are irregularly connected by means of channels running horizontally or in an oblique direction. If you examine the growing parts of the stem you will find that the bark, or—as it is better termed—the cortex, is formed from within outwards; new cells are continually being formed which push the older ones outwards. Now all these cells, at some time or other, are liable to undergo decomposition and to assist in the production of well-defined tubes which become filled with latex; it is obvious that the material now constituting part of the dead dry bark of your untapped trees was originally part of the cortex and at one time probably contained latex, but is now dry and all signs of latex in it are gone for ever. It is quite correct that this occurs originally, but it is as well to point out that much of the dry bark of old stems or even renewed bark arises in another way—from the cork cambium—and never contains any signs of milk tubes or latex. The fear of the milk tubes drying up and peeling away and the anxiety for preventing loss in any way are, however, no excuse for extracting the latex at too early an age.

MOST LATEX INNERMOST.

The bark of mature trees usually possesses a good proportion of milk tubes, most of which occur in the innermost part of the cortex, very near the cambium. It is a pity the higher proportion of laticiferous tubes are so near the vital cambium, but with the advent of two pricking knives already brought forward by Ceylon planters, the extraction of the latex from the treacherous and deeply-hidden area

hould soon be possible without doing much damage to the healing layer of the stem. At the present time the methods adopted to extract the latex from the innermost tubes are somewhat dangerous, as in nearly all instances the cambium is more or less damaged by the implements used.

I can imagine that most of you have heard quite sufficient about the dry revelations of the botanist and his tubular spectacles, and I therefore propose to conclude this brief survey of the laticiferous system with a few practical deductions to be drawn therefrom. Let us discuss the probable effects of extracting the latex by those methods which are in operation at the present time, and also touch upon other points of similar importance.

EFFECT OF REMOVING LATEX.

The questions to ask ourselves are: *What* will happen if we remove large quantities of latex from Para rubber trees? *What* will happen if the latex is not extracted, but allowed to remain in the laticiferous system? Will it increase in quantity or quality? To reply to these questions properly would take too much of your time; they open up a very wide field of thought regarding the possible functions of the latex, the time, frequency, and methods of tapping, and other subjects. To put matters briefly, the extraction of the latex, and nothing more, means the removal of what is considered to be mainly a waste or excretory substance, useful in times of drought or when the plants are punctured by various pests; it rarely contains appreciable quantities of material which can be used as food by the plant. Latex is not known in the majority of plants with which you are surrounded in Ceylon, and even when as much as fifty pounds or more are taken from one Para rubber tree in twelve months, and the bark terribly mutilated in the operation, the tree appears to flourish as if it had never been roughly handled. It is ridiculous to compare the laticiferous system of the rubber trees with the circulatory system of human beings, as it has no similarly vital associations with other parts of the tree; it is almost useless during the life of the tree, and persists when the tree is apparently dead. I would much prefer to compare its importance with the hair of human beings which can be regularly removed, and which usually as regularly reappears, than to that of our circulatory system, though even this comparison is probably misleading. If the latex is not removed from the tree, it may undergo chemical and physical changes and be finally cast off with the dry bark. Other trees, instead of casting off useless ingredients by means of the bark, deposit them in the old and functionless wood of the tree, and thus give us our ebony, calamander, and logwood of commerce.

INFERIOR RUBBER FROM THIRTY-YEAR-OLD TREES.

Many might reasonably expect that if the latex was not extracted it would become more concentrated and more rubber would be contained in a given volume of latex; this no doubt does occur to some extent, but it is a concentration which seems to be often accompanied by other complex changes which influence the properties of the rubber and finally give a larger percentage of ingredients other than caoutchouc. We have recently had an experience, which illustrates this point at Henaratgoda and Peradeniya. There we tapped for the *first* time some trees thirty years old, and in almost every case the first tappings, which drew out what might have been considered the concentrated caoutchouc emulsion of many years, gave us rubber of inferior quality; the same feature has often been observed in rubber from younger trees when tapped for the *first* time, and whatever may have been the causes at work, the results do not encourage one to leave mature trees alone for too long an interval, with the idea of getting a higher quality of latex at a subsequent date. No, Gentlemen, I am inclined to think, though I may be absolutely

wrong, that if we could extract the latex by some method which would not destroy the cambium or the bark (cortex), we might be able to almost drain the tree dry and still leave it standing. Some Para rubber trees have been known to be incapable of yielding latex during certain years; subsequently they gave latex in quantity. The milkless state did not appear to seriously affect the trees.

SPARE THE BARK, BUT GET THE LATEX.

In my opinion, it is not in the extraction of latex that the harm is done so much as in the removal of the bark containing that substance. The bark or cortical tissue, which is removed in tapping operations, contains organised systems of elements which are of vital importance to the plant, and on their health and continuity depends the perfect distribution, mainly from above downwards, of the food materials elaborated in the leaves. As a store house and conducting channel the cortex is of vital importance to the plant, and if it is removed too quickly the life of the tree may be endangered. The rapid stripping of the bark is an unnatural process, analagous, perhaps, to the treatment meted out to cinchona trees—though they did not flourish long—but not comparable with the natural peeling away of dry bark. During ordinary tapping operations the cortical cells are excised while they are in a living condition, and are entirely removed at a time when they contain reserve food intended for the use of the plant; it also differs from the natural peeling of the bark, in so far as the average operator exposes the inner and more delicate and vital components of the cortex and cambium to atmospheric influences. Such treatment does affect the vigour of the trees, and if cortical stripping is effected much more frequently than once in three or four years, I anticipate trouble in the future.

TOO FREQUENT TAPPING LOWERS THE YIELD.

Apart from the consideration of the after effects, there are others of very great importance to every planter who has to get the best yield posssible. The discovery, if so it can be named, is the outcome of observations made at Henaratgoda, where the trees have been tapped at all intervals ranging from once per day to once per month, on definite but different systems, and I have brought with me some photographs to illustrate what I wish to say. The results of experiments outlined to determine quite different points have shown a common agreement in so far that, when tapping has been done too frequently or too extensively, the yield of rubber has been seriously reduced, and the bark or source of future latex has gone. Many experiences have been already recorded in which surprise is evinced that well-developed trees in one country have not given the same yield of rubber as less vigorous specimens in Ceylon; in some of these cases the poorer yield from the better developed trees can be associated with the too rapid excising of the bark, and the sooner we all realise that the bark is really the "mother of rubber," and that its removal means a reduction in subsequent yields, the better for all concerned. It is, no doubt, encouraging to know that rubber can be extracted from the usual bark shavings, but a high yield therefrom is not what rubber planters should specially search for.

TAPPING EVERY DAY AND ALTERNATE DAYS.

One might at first conclude that, since the Para rubber trees rarely ever run absolutely dry, and most of them (no matter how roughly they have been handled) appear to contain an inexhaustible store of latex, the more frequently the trees are tapped the larger the quantity of latex obtainable. But curiously enough the series of experiments which I have in mind show the very opposite result, and though they may or may not be exceptions, they deserve consideration. The trees in one area have been tapped every day from September, 1905, and those in another group every alternate day from the same date. The trees which have been tapped every day (on 264 occasions) have given about 9 lbs. of dry rubber each, and all the original bark has

Photo by Ivor Etherington.

HEVEA BRASILIENSIS TAPPED EVERY DAY:
PARING AND PRICKING METHOD.
9 LB. DRY RUBBER FROM 264 TAPPINGS.

Photo by Ivor Etherington.

HEVEA BRASILIENSIS TAPPED EVERY ALTERNATE DAY

Paring and Pricking Method.

11 lb. Dry Rubber from 131 Tappings.

been cut away: those trees which have been tapped every alternate day (on 131 occasions) have given about 11 lbs. of dry rubber each and only half of the original bark has been removed.

These photographs show what I mean, very clearly. Tapping at less frequent intervals has not only given a higher yield of rubber per tree, within exactly the same period, but there is original bark remaining which will last for another nine months on each tree. We have saved in labour expenses, the yield has been increased, and the trees have been less drastically treated by tapping every alternate day instead of every day. There is some ground for believing that, when incision of the latex tubes is made more perfect than at present, the interval between each tapping operation may, with advantage, become still longer and yet be accompanied with a further increase in yield and saving of labour. While this is fresh in your minds, let me discuss with you another result which points in the same direction.

HALF-SPIRAL AND FULL SPIRAL TAPPING.

You are aware that all the systems of tapping have been tried, experimentally, at Henaratgoda. The results are too numerous to be placed before you in a single lecture; but I wish to point out that those systems of tapping, such as the half-herring-bone or half-spiral, which only allow the operator to tap one side of the tree at a time, though, in our experiments, they have given a lower yield per tree than the full herring-bone or the full spiral methods, yet the yield per unit of excised bark has been higher in the former than in the latter series, and there is plenty of the original bark still tappable. Reluctant as I am to give any appearance of finality to the available results of fragmentary experiments with Para rubber, I cannot pass over those just enumerated without asking you to consider them seriously, as they point to a common agreement explicable from our present knowledge of the origin and construction of the latex tubes in *Hevea brasiliensis*. If we could only obtain good series of results in different parts of Ceylon, we should soon be able to settle these important questions.

IMPORTANT POINTS TO CONSIDER.

To put the explanation in a nutshell, it is, I think, simply this: the latex tubes and their contents require an interval of time to form or accumulate; if they are tapped too frequently they are less turgid and the yield therefrom is reduced; if the bark is removed too quickly either by too frequent or too extensive tapping, the material wherein latex tubes might have subsequently developed is completely severed. If you leave the bark on the tree, for a certain interval, probably more latex tubes will be formed, and the yield per unit of excised bark increased. I am sorry to see that my time is up and I must stop. Now, Gentlemen, your turn has come. Your Secretary, Mr. Thornhill, who has taken a great deal of trouble over this lecture, has guaranteed that question time shall be animated and instructive, and having for my main object the stimulating of free, healthy discussion, I trust that you will not hesitate to bring forward many subjects of public importance. We can subsequently consider the microscopic slides which I have brought with me, if any of you care to probe a little deeper into the mysteries of the origin and construction of this interesting and important product. (Applause.)

DISCUSSION.

The CHAIRMAN:—Will any one who wishes to ask a question kindly stand up and ask Mr. Wright.

TAPPING SYSTEM AND YIELDS COMPARED.

Mr. THORNHILL:—May we ask what where the results from the trees you tapped twice a week in comparison with the trees which gave eleven lb. tapping on alternate days?

Mr. WRIGHT :—The results up to date are as follows :—Tapping every day has given an average yield of 9 lb. per tree, tapping every alternate day 11 lb. per tree, and from twenty-five trees tapped twice per week 91 lb. 2¼ oz., or little less than 4 lb. per tree ; in the latter group, the remaining bark will last 3 or 4 years. Tapping every alternate day has, up to the present, given the best yield of rubber. There is a rather peculiar feature observable in connection with Para rubber which is not always the case with other rubber trees. I refer to the wound response which takes place on tapping. It has been proved to occur in the Straits by Mr. Arden, and by Dr. Tromp de Haas in Java, and also by Parkin in Ceylon. The time required for this wound response to take place is from 24 to 48 hours. It is rather curious that that discovery should hit off the result we have obtained by tapping on alternate days, or every 48 hours, compared with those of tapping twice a week.

Mr. THORNHILL :—Then tapping every alternate day has given better results?

Mr. WRIGHT :—Yes, but I do not wish to give any appearance of finality to these fragmentary results we have obtained so far. They are interesting, and may some day be useful. but we may have to contradict them later. At present all that can be said is that tapping on alternate days seems to be better than tapping every day at Henaratgoda.

LATEX MORE ABUNDANT IN WET WEATHER.

Mr. THORNHILL asked the reason for there being more latex during wet than dry weather.

Mr. WRIGHT :—The reason you get more latex in wet weather is probably because there is more water absorbed by the roots. The more water absorbed by the roots, the more turgid the cells and the laticiferous system will become ; usually there is less caoutchouc in the latex collected in wet than in dry weather,

THICKNESS OF BARK AT DIFFERENT ELEVATIONS.

Mr. CLARKE :—Have you any data with regard to the thickness of bark at different elevations? For instance, at 2,000 feet is the bark thinner than at, say, fifty-six feet or the normal low-country elevation?

Mr. WRIGHT :—I have no figures giving exact measurements, but I have made observations on trees at various elevations to find out the different rate of growth of the whole of the stem. You usually find that the bark at high elevations is thinner than at low elevations in trees of the same age. If you work out the production of bark tissue and the wood, you will find these tissues are formed at a definite rate in a definite mathematical proportion, so many wood cells to so many bark cells. You cannot alter the proportion. If the tree grows at a slow rate it means that not only the wood, but all other parts, including the bark, grow at a proportionately similar rate. At high elevations the bark is usually thinner than at the low elevations in trees of the same age.

Mr. CLARK :—It might be interesting to state that that clearly corroborates what I experienced in South America ; I found the bark at 2,000 feet elevation very thin, and there we seldom met with the trees growing in a healthy way.

Mr. WRIGHT :—In Brazil?

Mr. CLARK :—No, tropical Peru. We found the bark there much thinner than at 56 feet, which was the lowest point we went down in the upper reaches of the Amazon.

THE MOST DRASTIC SYSTEM OF TAPPING.

Mr. THORNHILL :—There are one or two points in your previous lecture I should like to have explained. Mr. Thornhill then read the following extract from Mr. Wright's lecture :—

"You get more rubber in a given period of time from the full-spiral than from the herring-bone or by the half-spiral cut. When you come to work out the weight of rubber obtained per unit of bark excised, you find the full-spiral gives you the maximum rubber per square inch of bark cut away, and it may be considered the best system for places requiring thinning out."

Mr. WRIGHT :—Several people have brought this subject forward, and many seemed to wonder whether my statement meant that the full-spiral system, since it gives the maximum yield in a given period, was to be recommended on those grounds alone, or whether it was only to be recommended for estates which have to be thinned out. In my opinion there can be no questioning the statement for a single moment that the full-spiral system is the most drastic one that can ever be adopted in tapping. At the same time, if it is carried out properly, it is not the species of ringing which many people seem to think it is. At Henaratgoda we have been tapping for nearly a whole year, but, as you can see from these photographs, we have only worked through two or three inches of bark, though the tapping lines are above twelve inches apart, so that, even with the spiral system, we can go on tapping the original bark for three years. We can commence to tap the renewed bark when it is three to four years old. We know that the average Para rubber tree does not produce mature bark, fit for tapping, under four years. Renewed bark is a new creation, and the process of decomposition leading to the formation of latex tubes goes on in the same way as in the original bark; for the completion of these changes much time is required. The full-spiral system strips the whole of the bark; it gives a larger yield than some other methods, though it is probably less economical. As I pointed out, any method which is of such an extensive character as the full herring-bone, or full-spiral gives you a low yield per unit of bark excised. The photographs illustrate this point.

THE USE OF THE PRICKER.

Mr. THORNHILL :—Might I ask whether in these photographs the Northway-Bowman tapping knife was used? Did it cut through the cambium?

Mr. WRIGHT :—You can see where the pricker has been used; the impressions are visible on the photograph. Without a shadow of a doubt, the pricker reaches the cambium; the use of the pricker is to be recommended, but at the same time it should be remembered that it is disadvantageous in so far that it touches the cambium. I have examined such areas, but have not seen any very bad effects. Of course, the greater number of the latex tubes are disposed internally; they are found in largest proportion near the cambium, and you require the pricks to get at them. You can, with advantage, leave a good thickness of bark over this inner layer, and reach the latex tubes by means of a pricker.

TAPPING THE CAMBIUM.

Mr. THORNHILL :—Many of us have experienced that if you don't tap into the cambium you don't get good results.

Mr. WRIGHT :—Quite so, but it is not necessary to cut down right into the cambium to get the latex. The laticiferous system is outside the cambium or the wood.

Mr. THORNHILL remarked that very often rubber was found coagulated inside the bark, and when they pulled the bark off, they found pieces of rubber in the woody portion of the tree.

MR. WRIGHT :—It does not originate from latex tubes in the wood. It may have accumulated in a depression in the wood, made by some implement, borer, etc.

MR. THORNHILL :—It leaves a little hole.

MR. WRIGHT :—It cannot have originated in the wood. There is nothing in the wood of *Hevea brasiliensis* to give it. It may have got into a depression in the wood, and accumulated there.

WHEN CAN NEW BARK BE MOST PROFITABLY TAPPED.

MR. CLARK :—It would be interesting to know how old you consider the renewed bark—at what stage, or when you consider the renewed bark can most profitably be tapped.

MR. WRIGHT :—I cannot reply as to the age at which renewed bark could be most profitably tapped from any figures of exact yields, but I feel convinced that if the renewed bark is tapped when under three or four years, and repeatedly treated in the same manner, there will be some discouraging results. Consider the ordinary natural development of the plant; it takes three to four years for mature bark to be formed. You can never tap a tree under four years old. You see you are dealing with newly-formed material, and it probably takes, approximately, the same period of time for the laticiferous system to form in the new bark as it does to form in the original bark. Personally I would not recommend the tapping of the renewed bark, formed after complete cortical stripping until it was three or four years old. On some estates it is found convenient to arrange the tapping areas according to the points of the compass—East, West, North, and South. The East side is tapped in the evening and the West in the morning; this is carried on for two years. Then they tap the North and South sides during the next two years, and finally come back to the original side, which has renewed its bark at the end of four years. Of course, that is perhaps only necessary when cortical stripping is intended; with the small V system it might not be necessary.

THE "V" METHOD OF TAPPING.

MR. SEEL :—May I ask whether experiments are still being carried out with the V system of tapping?

MR. WRIGHT :—We have not done very much in the way of V tapping. We came to the conclusion that it was not a systematic method of tapping. It is far less systematic than, say, the herring-bone or spiral methods, where you can start above and work downwards through the whole of the bark. On the V system you cannot easily tap the triangular piece of bark enclosed by the sides of the V; you must tap on the lower or under surface. Very often with the V tapping the apex turns up and exposes the wood beneath. The V method is not a systematic one, though it has led to very good results in some cases. I don't see any special advantage in it over other methods.

TO PREVENT COAGULATION ON THE TREE.

MR. ARTHUR WATT :—What is the best means of inducing latex to run—to prevent coagulation on the tree?

MR. WRIGHT :—The only means available are of an artificial class. You can either use an old bitters bottle or a can—a drip tin—at the top of each cut. You fill the tins with water only or water with a little ammonia, or formalin. It is certainly a very great advantage; there is a saving of labour, and the cuts do not fill with scrap. You have a more or less clean cut to start with next morning. I went round an estate on Saturday last and was rather struck with the fact that they had nine boys taking up the scrap for twenty-seven tappers at work. That is

all very well so long as you have only a few hundred trees; but when you have thousands of acres, there must be some system which will ensure that the cuts can as far as possible be clear for the tapping next morning. I mentioned at Kegalla that one prominent V. A. told me he had reduced his scrap 75 per cent. by using these tins. I prefer not to use chemicals with the water though they will keep the latex liquid. I have kept latex liquid for four weeks by using formalin, but I prefer not to use chemicals at all for this. Ordinary water is good enough, if you have a good tin with a heavy drip.

"SPOTTY" BISCUITS.

Mr. WATT :—When we have too much water we get spotty biscuits?

Mr. WRIGHT :—I do not see why the rubber should be spotty because the latex is mixed with water. Of course, if you make bubbles, you must get rid of them. Bubbles are easily pricked or skimmed off. Perhaps you took two or more thin biscuits and put them together and got the air bubbles in between? That is often done when the latex is very watery and the biscuits very thin.

TRANSPORT OF UNCOAGULATED LATEX.

Mr. THORNHILL :—In the sweet future when we have got these thousands of acres you speak of in bearing, is it possible we may be able to send our uncoagulated latex down to Colombo to a central factory several miles off?

Mr. WRIGHT :—Some of you, Gentlemen, have got to send your latex every day to the Rubber Exhibition in a liquid condition. We look towards you for it. It is certainly possible to send the latex in a liquid condition though there are great difficulties in the way. It may appear an easy matter, but I recommend you to try it with an ordinary kerosene or rectangular tin provided with one hole in a corner, I should like you to make a trial and see how long you can keep the latex in a liquid state in such a receptacle. It is not always very easy to send the latex in a liquid condition over a long distance. Latex can be kept liquid; it has been kept in that state for four weeks and at the end good commercial rubber prepared from it. I once read of an account to the effect that latex had been sent from the Amazon district to France.

LATEX FROM RUBBER SEED.

Mr. P. D. G. CLARK :—In the case of young fruit or mature fruit, has it been ascertained what proportion of latex can be obtained from it at certain stages of its development?

Mr. WRIGHT :—From the fruit?

Mr. CLARK :—Yes, I ask the question in view of the glut in the seed product. Seed will no longer be required, perhaps, in a couple of years hence, and I consider a very large quantity of latex can be got from the young fruit at a certain stage, What the best stage is I am not quite sure.

Mr. WRIGHT :—I think that, as Mr. Clark says, you can obtain a certain amount of latex from the fruit wall and the substance of the seeds; you can see that it is possible, from the slides which I have brought with me; there are little rubber globules accumulating in the young latex tubes. But if you take a large quantity of seeds and crush them, you will obtain a disappointing result. There is only a very low percentage of caoutchouc in the latex of the seeds although the latex is abundant enough. There is a lot of latex in the leaves and twigs of the tree, but it is very difficult to make proper rubber from it. I think the oil from the seeds will come forward very soon, seeing that London firms are keen on it. They are making experiments with it, I understand.

Mr. THORNHILL :—What will it be used for?

Mr. WRIGHT :—After expressing the oil there is a residual cake which can be used as food for cattle.

THE EFFECT OF OVERTAPPING ON SEED BEARING.

Mr. WATT :—If a tree is tapped to the fullest extent, would it not prevent the seed from forming at a later period ?

Mr. WRIGHT :—Will over-tapping affect the seed ? That is what your question really amounts to. There are some people who believe it will, and others believe it will not, and consequently they are always disputing whether they should select seeds from trees which have or have not been tapped ; or whether tapping operations should be suspended while the fruits are forming. I do not know any one who can give a definite opinion on the matter. My private opinion is that provided the trees are not harshly dealt with, the tapping operation has very little effect on the seeds. If, on the other hand, you badly damage the tree, the effects will naturally be obvious on other parts including the seeds. Personally I should like to select my seeds from trees that had been tapped and proved to yield latex. There are some Para trees which, when tapped, did not give latex ; if you select seeds from trees that have not been tapped, you may be selectign seed from trees that will never give you the required quantity and quality of latex. It is a very complicated matter. Provided the trees have not been roughly handled, I see no reason why we should not have the seed taken from big trees that have been tapped and have given a fair quantity of latex.

VARIATIONS IN THE QUANTITY OF SEED PRODUCED.

Mr. THORNHILL :—Last year we got 80,000 seeds from tapped trees. This year we did not tap and we got 280,000.

Mr. WRIGHT :—Do you ascribe that to not having tapped ?

Mr. THORNHILL :—I do ascribe it to that. They only gave 60,000 before, and they never had been tapped then.

Mr. WRIGHT :—You can tap in a way to threaten the life of the tree ; and if you do that, the tree immediately shows a disposition to produce a large quantity of flowers and seeds. Take a cacao tree and ring it ; the upper parts will simultaneously burst into blossom. There are other plants which behave in a similar way ; check or cut off their water-supply and seed-like structures will appear in an interval of a day or so, as a last effort to propagate their kind. In the same way if you overtap a tree you may lead to the production of a large blossom and seed crop. I hope that was not the case here ?

Mr. THORNHILL :—I do not think that was the reason here. It certainly was not over-tapped. The bark was renewed and we had started to tap again.

Mr. WRIGHT :—What was the average yield per tree each year ?

Mr. THORNHILL ;—300 seeds per tree I got, but there is a vast difference between this year and last.

Mr. WRIGHT :—There is nothing abnormal in that. The trees ought to mature and give a larger number until they yield an average of about 500 seeds per year, judging from the number of seeds we have distributed from Henaratgoda.

RUBBER SUBSTITUTES.

Mr. JOHN HILL :—With reference to Mr. Thornhill's " sweet future " and Mr. Clark's "glut," can you tell us if they are likely to get a substitute for rubber in the future.

Mr. WRIGHT :—Ask an easier one, please. It is necessary to distinguish between substitutes and artificial rubber produced synthetically by the chemist. (Laughter.) We are trying to arrange for an exhibition of rubber substitutes

at Peradeniya next month, and to show, if possible, the proportion of substitutes which are being used in the manufacture of different goods. So long as the price of pure rubber is high, people will use paper, &c., in preference if they can make a good article. Tobacco pouches and similar goods have a high percentage of caoutchouc, but even then there are fatty and other substitutes used. There is hardly a single article made of pure rubber. There is a large percentage—25 to 50 per cent or even more—of fatty and other substitutes used in most things.

ROOT DISEASE: THE REMOVAL OF STUMPS.

Mr. THORNHILL:—We should like to hear something about root disease, which is supposed to spread along forest trees. We should like to know if all stumps should be removed in clearings.

Mr. WRIGHT:—Mr. Crabbe tried to draw me out on that point. It is, of course, really a question for the Mycologist to answer. I have nothing to do with diseases. The particular subject mentioned has been studied by Mr. Petch, and a circular has been issued by him, giving the results. You should certainly all get it at once from the Director. Several planters are, I believe, going to the expense of up-rooting stumps. It is for that reason, we tried to draw on your inventive faculties in connection with the Rubber Exhibition. We put down a prize for the best method of destroying—or implement for extracting—stumps in rubber clearings. I have heard of people up-rooting stumps and getting a part return in root firewood. They make out a fairly good case.

SUITABILITY OF RATNAPURA AND SABARAGAMUWA FOR PARA RUBBER.

RAINFALL AT HIGH ELEVATIONS IN CEYLON.

Mr. Wright's labours did not end with the proceedings at the lecture and the number of questions put and answered after the formal proceedings had closed was probably far greater than those asked at the lecture itself. Much valuable information was imparted in this way. For instance one planter asked:

What do you think about our district for Para Rubber?

Mr. WRIGHT replied—We know that Para rubber does very well indeed in this district, and that its cultivation has long ago passed the experimental stage. Nevertheless, this is not a district to come to without a raincoat and umbrella, is it? I have had a fair experience in this and the districts close by, and shall never forget how, in searching for ebony and guttapercha trees around Hewesse, Eratua, Hiniduma and the Peak Wilderness, I had frequently to be carried on coolies' backs over large tracts of flooded low land. There is no questioning the point that you have, in some parts of this district, more than the required quantity of rain for Para rubber; the effect of a heavy rainfall can to some extent be mitigated, of course.

Will a very heavy rainfall do much harm to the rubber.

Mr. WRIGHT:—The evil effects of a too abundant rainfall, as far as the soil is concerned, can to some extent be probably overcome by deep draining. Deep drains would allow anyone, on land with a slight slope, to more quickly dry the superficial layers of soil; it would prevent water-logging and would ensure a better circulation of air through the soil and the temperature of the latter would certainly not be lowered by such work. A swampy water-logged soil contains the equivalent of a rainfall much heavier than has ever been recorded in Ceylon, but, nevertheless, when properly drained it grows excellent rubber. It is surprising to see what has been accomplished in the Udugama, Bentota, Ambalangoda and other districts, where waste swampy patches have, by means of very deep and wide drains, been converted into decent rubber

Is the climate unfavourable?—persisted the planter.

Mr. WRIGHT:—When I said that you had, in some parts a heavy rainfall at high elevations which might be undesirable, I had in mind the vegetation on, and the damp climate at, Hinidumkande; the hill is only, if I remember correctly, a little over 2,200 feet at its highest point. On the lower part of that hill, and the district around it, the vegetation is very similar to what one finds in the Ratnapura district. But as soon as you get 2,000 feet up the hill the arborescent vegetation is completely changed; instead of the stalwart lofty trees of Vateria, Diospyros, Dipterocarpus, Palaquium and Canarium species so common in the lower part, you find the tree forms all stunted in growth, the foliage is poorly developed and the trees are all covered with mosses, lichens, liverworts and even saprophytic fungi. The change in the whole type of the vegetation is remarkable and the air is damp and cold throughout a great part of the year. I do not for a moment say that *Hevea brasiliensis* would not grow, even at the top of Hinidumkande, but the trees in such a climate would not mature as quickly as under more favourable conditions.

Is it the elevation or the rainfall?

Mr. WRIGHT:—The rainfall is, perhaps, the more important factor. On Passara Group Estate, Passara, with a relatively small rainfall, but at an elevation of 2,600 feet, Mr. Stewart Taylor has obtained over 2 lb. of rubber per tree for 1905. Again, many places in South India, though over 3,000 feet above sea-level, but with a meagre rainfall, grow Para rubber satisfactorily. An estate at an high elevation with a low rainfall is very often more suitable than one at a similar elevation with a heavy rainfall; for instance, I should prefer Passara to the top of Hinidumkande. A high rainfall at a high elevation is bad for Para Rubber.

TREES WITHOUT LATEX.

But is it correct that several trees at high elevations give very watery latex and some none at all?—queried another.

Mr. WRIGHT:—Yes, occasionally.

What is the reason for such behaviour; it surely cannot be general?

Mr. WRIGHT:—You must make up your mind to expect great variations in the nature and yield of latex from trees at all elevations, for the simple reason that the laticiferous system, from which the milk is obtained, is not a vital part of the tree. There is, of course, a general constancy and the majority of the trees of *Hevea brasiliensis* possess latex throughout their lives; but in some cases the trees do not yield normal latex during certain periods, though subsequently they contain this mixture in large quantities. Generally speaking, one may say that there is less constancy in parts of the plant which are not of vital importance, than in those upon which the continuity of the tree's life depends; for instance, the peculiar cells which are of vital importance and conduct and store food materials from the leaves —phloem tubes and companion cells—are much more constant in the cortex of *Hevea brasiliensis* than are the non-vital latex tubes. There is no need to get alarmed at the fact that the latex is occasionally almost absent or possesses a low percentage of rubber globules; it is a natual variation which must be expected, considering the non-vital functions of the latex and the hundreds of thousands of trees there are of the same species—already there are planted in Ceylon about 20,000,000 Para rubber trees, I understand.

SELECTION OF SEED PARENTS.

A third planter wished to know, What should be done to such trees. Should seeds be used from such trees for planting?

Mr. Wright —Seeds, from trees which show irregularity in quality or quantity of latex, should perhaps not be used for planting. It is difficult to give advice on the subject of selecting seed parents when all the trees are healthy. Personally, I think I should select my seeds from the best developed trees on the estate,--those which showed the best growth of foliage and girth and a corresponding laticiferous system. It seems to me, though I may be quite wrong, rather dangerous to select seeds from trees which have never been tapped, though many applicants for Henaratgoda seeds specify such desires very frequently; you may be selecting seeds from trees which, had they been tapped, would have given you the minimum quantity of latex, or perhaps none at all. Then where will you be? Provided the trees have not been roughly handled in tapping operations, I do not really see that there is any great mistake in selecting, as seed parents, those trees which are best developed and have given fair yields of latex. There is a theory abroad that you can induce characteristics in the vegetative parts of plants which can be fixed and transmitted from generation to generation, in which case the selection of seeds from the best yielding trees might ultimately give very good types of rubber trees. But the theory of transmission of characters acquired in successive generations is hotly contested by many botanists, and it has not yet been proved that it occurs with the latex tubes of *Hevea brasiliensis*. It is a complicated subject and one requiring much experiment. Of course, in this, as in other matters I am expressing my own private opinion, which may be quite wrong. The subject is very interesting, and it is just as well that you raised it, but I have to impress upon you that it is only my opinion and you should not accept it as gospel, without consulting others.

THE LONDON RUBBER MARKET.

London, July 20.—At the auctions to-day the following lots, comprising about 2 tons of Ceylon and about 6 tons Straits and Malay States were offered, and Ceylon sold as follows:—

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
Wiharagama	6 cases Biscuits mixed colours very greasy surface at 5s. 9d.
M in estate mark	2 do Fine pale Ceara biscuits at 5s. 9¼d.
	1 do Good Ceara scrap at 4s. 9d.
Waharaka	1 do Biscuits mixed colours at 5s. 9d.
	2 do Fair scrap at 4s. 9d.
Ballacadua	1 do Black heated chip crêpe at 2s. 6d.
Dolahena	1 do Common scrap at 4s.
Baddegama	1 bag do do at 4s.
H L K in estate mark	1 do do do at 4s.
Langsland	5 cases Fine biscuits mixed colours at 5s. 9d.
	1 do Good scrap at 4s. 9d.
Culloden	5 do Fine pale but mouldy biscuits at 5s. 9d.

Para.—The market has been firm during the week and prices are rather higher. Business has been done in Hard Fine at 5s. 1¼d. to 5s. 2d. on the spot and at 5s. 2d. to 5s. 2½d. for forward delivery. Soft fine 5s. ½d. per lb.

Plantation Para.—In better demand for sheets and biscuits at about ½d. to 1d. per lb., higher prices. Crêpe slow at sale. Scrap in demand at 4s. 9d. for fair. 203 packages offered and 75 sold. Biscuits and sheets 5s. 8d. to 5s. 9d.; 2 cases very pale 5s. 9¼d. Crêpe all retired; scrap 4s. to 4s. 9d. according to quality.

Colonial Rubber.

Nyassaland.—4 packages offered and sold. Good red ball 4s. 3½d. per lb.

Assam.—71 packages offered and 14 sold. Livery 3s. 4¾d. per lb.

Penang.—18 bags offered and 15 sold, reddish and white mixed part stained black 2s. 11½d. soft sticky 1s. 4s. per lb.

LEWIS AND PEAT,

London, July 27.—The market closes rather quieter with sellers of forward delivery Hard Fine at 5s. 2¼d., after business at 5s. 2½d. and 5s. 2¾d. Soft fine, sales at 5s. 1¾d. and 5s. 1½d. afloat, closing with sellers scrappy Negroheads firm, value about 3s. 10½d. Cametas sales at 3s. 0½d. Island Negroheads, buyers 2s. 9½d. Caucho Ball, considerable business has been done, sales of Upriver Ball, August to September delivery at 3s. 9½d. and spot at 3s. 9¼d. For medium kinds demand continues rather slow, but crêpe plantation has met a better demand.

S. FIGGIS & Co.

London, August 3rd.—At to-day's auction, 202 packages of Ceylon and Straits Settlements Plantation grown rubber were under offer, of which about 162 were sold. The total weight amounted to about 11½ tons, Ceylon contributing about 3¼ and Straits Settlements nearly 8¼. Considering the near approach of the holidays and the consequently small attendance, the demand for the fine quality cultivated rubber was fairly satisfactory, though prices were sometimes fractionally lower than rates ruling at the last auction.

A few parcels of very fine pale bright biscuits and crêpe from Ceylon were well competed for and realised up to 5s. 9¼d. per lb., the highest price of the Auction.

Orders for scrap and the lower kinds of crêpe were again wanting, but for the better qualities of the latter grade there was more enquiry than at the last Auction. Plantation Fine To-day.—5s. 8d. to 5s, 9¼d., same period last year, 6s. 1d. to 6s. 3d.

Plantation Scrap.—About 4s. to 4s. 8d., same period last year, 4s. to 5s. 1d.

Fine Hard Para (South American).—5s. 2d., same period last year, 5s. 6½d.

Average price of Ceylon and Straits Settlements Plantation rubber.—161 packages at 5s. 6d. per lb., against 77 packages at 5s. 3½d. per lb. at last auction. Particulars and prices as follows :—

CEYLON.

Mark.		Quantity, Description and Price per lb.
Talagalla	1 case	fine darkish biscuits, 5s. 8¾d.; 1 case fine pressed scrap, 4s. 6d. bid.
Warriapolla	7 do	fine pale to darkish biscuits, 5s. 8¾d.
Syston	1 do	fine amber sheet, 5s. 8¼d; 2 bags darker, 5s. 8¼d.; 1 bag good pale biscuits, 5s. 8¼d.; 2 packages darker, 5s. 8¼d.; 1 case barky scrap, 3s. 6d.
Doranakande	4 do	dark biscuits, 5d. 8¼d.; 1 case dark rough sheet, 5s.; 4 cases fine palish to darkish scrap, 4s. 4d.; 2 cases dark scrap, 4s.
Palli	3 do	fine palish Ceara biscuits, 5s. 8d.; 2 cases little cloudy, 5s. 8d.; 1 case rougher, 5s. 7d.
V. S. (in Estate Mark) K. M.	1 do	rejected biscuits, 5s.; 2 cases mixed scrap, 3s. 6d.; 1 bag rough Ceara biscuits and rejections, 4s. 3d.
Wiharagama	1 do	ball scrap, 3s. 6d.
Culloden	5 do	very fine pale biscuits, 5s. 9¼d.; 2 cases very fine pale block crêpe, 5s. 8¾d.; 2 cases fine pale pressed crêpe, 5s. 8¼d.; 1 case darkish, 5s. 6d.; 5 cases darker, 4s. 10d. bid.
Ellakande	2 do	fine dark biscuits, 5s. 9d.
Heatherley	2 do	fine pale biscuits, 5s. 9¼d.; 2 cases darkish pressed crêpe, 4s. 9d. bid.
Ingoya	1 do	fine pale biscuits, part heated, 5s. 7¾d.; 9 cases little darker, 5s. 8¾d.; 3 cases fine palish pressed scrap, 4s. 6d. bid.

STRAITS SETTLEMENTS.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
S.P. (in circle)	1 bag pressed scrap, 3s. 6d. bid ; 1 case fine amber sheet, 5s. 8¼d bid ; 1 case paler 5s. 8d. bid.
W.P.M.	5 cases good darkish amber sheet, 5s. 8¼d.; 1 case thick black crêpe, 2s. 3d.
P.R. S.B.	7 do fine darkish sheet, 5s. 8½d.; 6 cases good dark scrap, 4s. 0½d.
G.M. S.B.	4 do fine amber sheet, 5s. 8½d.
(V.R.Co.Ltd. Klang F.M.S. in triangle)	20 cases fine scored sheet, 5s. 8¼d.; 4 cases good palish pressed crêpe, 5s. 4½d.; 2 cases darkish, 4s. 2¼d.
C.R. (R.W. & Co. in triangle)	1 bag good rough sheet, 5s.
S.R. & Co.	1 case thick palish pressed crêpe, 5s. 1d.; 2 cases thin, 3s. 6d.; 5 cases darker, 5s. 1½d.
G.U.L.A.(in diamond)	4 do fine thin pressed sheet, 5s. 8¼d.; 1 case good pressed scrappy sheet, 4s. 3d.
P.S.E. (in diamond)	5 do fine palish amber sheet, 5s. 8¼d.
B.R.R. & Co., Ltd.	4 do fine darkish and dark amber sheet, 5s. 8¼d.; 5 bags good cuttings, 5s. 1¾d.; 9 cases fine scored amber sheet, 5s. 8d. to 5s. 8¼d.; 1 case paler, 5s. 8d.; 3 cases good pale and darkish crepey sheet, 5s. 6d.; 3 bags good cuttings, 5s. 0½d.; 6 cases good darkish amber sheet, 5s. 8¼d.; 2 cases palish to darkish scored sheet, 5s. 8d.

SHIPMENTS OF PLANTATION RUBBER.

Exports from Colombo and Galle from 1st January to 9th July.

1906	64½ tons.	1904	17 tons.
1905	23 ,,	1903	10 ,,

GOW, WILSON & STANTON, LTD.

THE ZAPOTE TREE AND CHICLE GUM (ACHRAS SAPOTA).

By A. J. LESPINASSE.

Among the numerous natural products abounding in this fertile region (the Mexican canton of Tuxpam) the Zapote tree stands pre-eminent, its gum and wood during many decades having formed a source of wealth to a large number of individuals and corporations, native and foreign, which have obtained from the State Government proprietary rights or concessions to extract chicle gum.

The wood of the zapote tree is dark purplish red, and although exceedingly hard when first cut it is easily worked until thoroughly seasoned, when only the finest edged tools have any effect on its flint-like surface. Sharp pointed nails can be driven into the wood only about an inch. The fibre is so dense that the wood sinks rapidly in water, and will remain immersed for years without being affected in the least. Zapote door frames in the ruins of Uxmal are as perfect to-day as when first placed in position. The wood is susceptible of a beautiful polish. The average zapote will square 5 to 8 inches and occasionally 2 feet. It is claimed that the bark is employed to great advantage in tanning processes, and that leather so treated is superior to other kinds.

The magnificent trees are rapidly disappearing, as the operators are taking no precautions to protect them from the destructive methods of the chicleros, who, in their greed to obtain all the sap possible, cut the trees so deep that they do not recover from the effects of the incisions, but gradually decay. Before the trees reach this stage, and while easy to work, they are cut down and shaped into building material.

The chicle industry extends from this section as far as the extreme southern portion of Yucatan, which produces the largest yield, but in quality the gum is

inferior to that obtained from this section, especially in the Tuxpam district. The latter gum commands a higher price in the United States, to which it is almost exclusively shipped.

Zapote trees thrive best on high, rolling land, and although trees are found on the lowlands, they are inferior in both sap and wood. Continuous tapping does not appear to have a seriously detrimental effect, provided the incisions are not too deep. Trees are known to have been tapped for 25 years, but after that time produced only from half pound to two pounds of sap. If allowed to rest five or six years they will produce from three to five pounds. The average height of the trees is about 30 feet. Zapotes are exceedingly slow in growth, and require from 40 to 50 years to attain full height.

The chicle season opens early in September, though the yield at this period is limited, and, owing to still copious rains, the chicleros (labourers) are retarded in their work; but this is to a great extent a benefit, as rains are favourable to an abundant flow of sap, provided the rainy season is not prolonged beyond October, in which case sap would contain a larger proportion of water, and the loss in condensation would be heavy and the product inferior. New trees will produce from 15 to 25 pounds of sap, according to size. In order to produce 25 pounds a tree would have to square about 2 feet and be from 25 to 30 feet high.

The process of extracting the sap is extremely primitive. Open V shaped incisions are made in the tree trunks, permitting the sap to flow in a continuous stream. At the foot of each tree a palm or other appropriate leaf is fastened, which acts as a leader or gutter from which the chicle drips into the receptacle placed to receive it. The sap as it flows into the incisions is beautifully white, has the consistency of light cream, but as it runs down it gradually becomes more viscous, until, as it drips into the receiving receptacle, it is of the density of heavy treacle. It is very adhesive, and is extensively employed for repairing broken articles and fastening leather tips to billiard cues. When the receptacle is filled it is emptied into a large iron kettle mounted on a temporary stone foundation, with a small opening for wood, the fuel used in the boiling process to evaporate the water, which amounts to about 25 per cent. of the sap. As the boiling progresses the chicle thickens, and when it has reached the proper consistency it is allowed to settle until a trifle more than lukewarm, when it is kneaded to extract more of the water content, and is then shaped by hand into rough, uneven loaves weighing 5 to 30 pounds. If carefully cooked it is of a whitish gray shade; if carelessly handled and improperly boiled it is a dirty dark gray. When prepared with extra care it is of a light pinkish colour. Much deception is practiced by the chicleros, who, in order to increase the weight, insert stones, bark, sand, or wood in the boiling chicle before it is formed into loaves. The sap freshly extracted will weigh about 7 to 8 pounds to the gallon.

Prices in this market range from $8 to $15 Mexican currency [15s. 10d. to 29s. 10d.] per 25 pounds; last season the average was about $14 [26s. 9d.] per 25 pounds.

If a good worker, a chiclero can obtain from 50 to 75 pounds of chicle a week, for which he receives 20 cents Mexican [4¾d.] a pound. As a rule, arrangements to extract the chicle are made with capataces (contractors), who have charge of the men. They receive about 40 cents Mexican [9½d.] per pound, and from this price they must feed and pay their employees.—*India Rubber World.*

[This tree, the Sapodilla plum, is cultivated to some extent in Ceylon for its fruit. The latex does not yield rubber, but a substance more like that which dries from jak milk. There is a considerable industry in it in America for making little statuettes, and other purposes.—ED.]

FIBRES.

Cotton in Ceylon.

By J. C. Willis.

As soon as the North country of Ceylon began to be opened up by the new railway, the question came up of what products might be commercially cultivated in it, and among these cotton, which was already grown in small quantities on chenas, naturally took the first place. Going on leave in 1902 I interviewed the chief officials of the newly-founded British Cotton Growing Association, and went over the cotton districts of Texas, etc., to get all possible information, and on my return Government agreed to open an Experiment Station in the North-Central Province. After some consideration this was done at Maha-iluppalama, and cotton seed from America (West Indian Sea Island and Uplands cotton) and Egypt (Egyptian) were sown there in the North-East monsoon of 1904.

The crop was gathered during the first six months of last year and ginned, and was baled and despatched to Lancashire early this year. The results were that two bales Sea Islands sold at 1*s.* two at 10*d.* a lb., while of the 13 bales of Egyptian cotton, 7 sold at 9*d.* to 9½*d.* per lb., 2 at 8½*d.* per lb., 2 at 8*d.* per lb., and 2 at 7¾*d.* per lb.

Leaving out of account the salary of Superintendent, and cost of opening the land, the return shows a fair profit, being for Sea Island Rs. 87 per acre, for Egyptian Rs. 71·25, while the cost (weeding for 8 months at Rs. 5, planting Rs. 3, picking and ginning Rs. 2) was about Rs. 45. The profit may thus be about Rs. 40 per acre, or even more on land not requiring so much or so expensive weeding, so that 100 acres should provide a fair salary for a Superintendent and anything over that should yield a profit beside, even in the very expensive North-Central Province.

The great thing to be attended to, however, if the quality of the crop is to be kept up, is selection of seed, which is dealt with in this month's leading article.

It is impossible to buy selected seed of Sea Island cotton, and this crop was grown from ordinary West Indian seed, the crop from which it was obtained having sold for 1*s.* 2*d.* or more, so that deterioration is evident in the very first generation. Thanks to continual selection, the quality of the West Indian Sea Islands cotton is rising, and has even reached 1*s.* 8*d.* a pound, so that now almost *any* seed from there is comparatively good, but its offspring will not remain so without regular selection.

EDIBLE PRODUCTS.

The Germination of the Coconut.

By Ivor Etherington.

The seeds of most plants grown as agricultural crops are so small that no attention need be given to the position of the seed in the germinating bed, particularly in the case of minute seeds scattered broadcast or sown by means of a seed-drill. Even with much larger seeds of the planting products of the tropics, such as tea, cacao, and the species of rubber plants, Ceara, Castilloa and Hevea, there is no necessity to take precautions that the seed may lie in any particular way in the soil. However placed the seeds seem to germinate equally well, and the young seedling plants grow up equally straight and sturdy. The coconut, however, has such a very large seed and the aperture in the kernel, through which the embryo plant has to push its way up through the surrounding husk, is so placed that the position of the coconut on the seed bed is of some importance in its germination.

If the nut is laid on its side, horizontally, or nearly so, the plumule and radicle grow vertically up and down in a straight line through a minimum of the surrounding husk, and the water in the kernel reaches the germ and keeps it moist during germination. This the native Sinhalese practice from their empiric knowledge.

An extensive series of experiments in the germination of coconuts has lately been brought to a conclusion in Madagascar, and the results have been published by Mons. E. Prudhomme, Director of Agriculture of Madagascar, in his book "Le Cocotier." In order to ascertain what are really the advantages or disadvantages of the different positions which can be given to a nut at the time of sowing, he compares the results given by the germination of five plots of fifty nuts placed in the following five positions:—

(1) Nuts placed vertically, point downwards.
(2) Nuts ,, ,, point upwards.
(3) Nuts placed obliquely, point downwards.
(4) Nuts ,, ,, point upwards.
(5) Nuts placed horizontally.

The point of the nut is understood to be the end opposite the stalk.

The nuts germinated in all five positions, but not with the same facility in every case, and Mons. Prudhomme makes interesting remarks on the result. In position (1) the germ has to make a fairly long passage through the surrounding husk (fibre) before breaking through it, especially in those nuts which are characterised by a great thickness of fibre on the peduncle end of the nut, such as the long shaped green coconut, the Seychelles coconut, and the long pointed "Pondicherry red," and others. In this position the plumule grows quite vertically just to the spot where the stalk of the nut is, or just beside it. Germination then takes place under good conditions; besides, in this position the nuts occupy very little room in the first seed bed; but against this it can be argued that it furnishes plants less able to resist wind and not holding in their places so well when planted out in the field. "However that may be, I have seen this method employed on a large scale, in the north-west of Madagascar, by a planter who has assured me that it is very satisfactory." I cannot say much, continues the writer in the French, for the 2nd position; (nuts vertically, point upwards) which seems altogether illogical, because the future stem is obliged to curve on itself and to follow round

the wall of the nut proper to the surface of the enveloping fibre. In this case the germinating point first shows itself on the side of the coconut, downwards from the point. The issue of the plumule is in this case much slower; this is easily understood on account of the deformation undergone by the young growing stem and the long way it has to grow from the interior of the mesocarp. Nuts placed in this position, according to the trials of the Madagascar Agricultural Department, gave a smaller percentage of successes than any of the other four positions. Further, plants of this sort are transported with difficulty, for there is risk of damaging the young stems in placing them side by side in a box or case, for instance when taking them to the field for planting.

The last three positions have given almost identical results. This is understood since, in the three cases, the growing stem has almost the same passage to make in growing from the kernel. Position No. 3, (nut placed obliquely, point down) which is the most logical as it corresponds with that which the nuts naturally take when they fall to the earth, seems to be the best. The horizontal position and that in which the part next the peduncle is slightly raised, are according to Mons. Keating, who carried out the experiments, the two best. In the horizontal and oblique positions the germinations seem apparently better than those in which the nuts are placed vertically.

The following table, drawn up by Mons. Keating (Madagascar Agricultural Department) shows the results of his experiments with 250 nuts.

	Nut vertical.		Nut oblique.		Nut horizontal.
	Point down.	Point up.	Point down.	Point up.	
Germination	66 %	48 %	86 %	72 %	84 %

In Ceylon experience bears out the results of Mons. Prudhomme's experiments. To enquiries made of several coconut planters of long experience in the island, the answer has in nearly every case been the same, viz., in favour of horizontal planting. Mr. Gerald Nicholas, of the well-known Golua Pokuna estate (whom, by the way, Mons. Prudhomme refers to several times in his work) says:—"I am of opinion that the best way to plant seed coconuts in a nursery is to place them horizontally—exactly in the actual position they lie on the ground when they fall from the tree. I should say a somewhat oblique position, with the point or stalk end of the nut upwards, would certainly be preferable to planting it vertically." In "*The Tropical Agriculturist*," April, 1895, Mr. Nicholas gave his reasons for objecting to the vertical position as follows:—"When the capsule at the stalk end drops off, it lays bare a depression in the husk directly above the 'eye' of the nut through which the young shoot issues. This depression is comparatively a tender spot in the husk and moisture would enter through it more easily than elsewhere. Therefore, if the nuts be placed vertically with only the spaces between them filled with soil, water would be caught in the depression, and, if superabundant as in the long-continued wet weather, the germ would be endangered." Mr. A. W. Beven, of Horekelly, says:—"I have always advocated their being placed in the same position they occupy when they fall from the tree, *i.e.*, sideways. I argue that the water in the nut is intended by nature to keep the germ supplied with moisture during the period of germination. If placed in this position, the nursery will to a very great extent be independent of watering, as was conclusively proved recently on an estate in the Rajabadalawa district, adjoining Toynbee. During a period of drought no water was available for the nursery within half a mile, yet almost every seed nut grew. Besides, it sometimes becomes necessary

to stake the young plant to prevent it floating when the hole becomes filled up with water during heavy rains immediately after planting, or to prevent it being blown down. Then the advantage of planting the nuts on their side becomes apparent."

The depth to which the seed nut should be buried has also been the object of experiments at Madagascar. Mons. Prudhomme writes as follows on this point:—

Nuts buried to a depth of 10 centimetres (4 inches) placed in the soil just up to the middle, or sunk just to the level of their tops, have given appreciably the same results. The rate of germination was almost the same in each of the three cases, and also the percentage of results has only given insignificant differences. It has not been the same in the case of nuts simply placed on the soil; the germination of these was much later and very obviously inferior to that of nuts more or less buried. It is certain that this method is not to be recommended. The other three methods gave good results, but as burying to the depth of 10 centimetres (4 inches) certainly costs much more, and, according to Mons. Keating's observations, requires at least twice as much labour as the others, superficial burying should be recommended. According to Keating, a man on an average can place 500 nuts a day in the nursery if they are planted just about level to their tops, and only 200 if buried to a depth of 10 centimetres (4 inches).

Prudhomme reccommends the nursery system as practised in Ceylon. He says, the Ceylon planters as a rule place the nuts at first side by side, first in a sheltered shady location, and transplant them to a temporary nursery protected against the sun's rays, 40 to 50 cms. (4 to 5 inches) apart, until the young growths attain to a length of 5 or 6 cms. "This method is certainly the most rational and, in my opinion, most to be recommended, for it allows the shade to be regulated according to the state of development of the young plants and diminishes the space occupied by the nuts. It is posssible in these conditions, to reduce to a minimum the work of looking after the young plants."

PARAGUAY TEA.

When speaking of Paraguay or Jesuit's tea it must be understood that what is referred to is not strictly speaking a tea at all, except in so far as the infusion thereof may be so called. The plant from which it is commonly obtained is "*Ilex paraguariensis.*" How many other plants yield Paraguay tea and their exact botanical designations are still matters of debate among botanists. In an article which appeared some years ago upon the subject, in addition to several species of *Ilex*, a species of *Symplocos* and one of *Elaeodendron* were stated to yield the tea. The native name for the tea in its raw state is yerba, but as that is simply a word meaning herb, it does not convey very much; as manufactured ready for use it is known as yerba maté. The latter word is apparently an arbitrary word peculiar to South American Spanish, and it is also used to denote the gourd or cup from which the tea is taken. Although belonging to the same genus as does the common English holly, there is very little resemblance to this in the yerba plant; the leaves are lance shaped, of a deep glossy green and soft, almost oily to the touch when fully grown; when young there is a flush of scarlet in the green. The flowers are inconspicuous. The trees attain a height of 40 feet or perhaps more when full grown, and the trunk is 12 inches in diameter, although 6 inches to 8 inches is nearer the average. The wood is soft and pithy and is useless as a timber.

The plant grows in forests, principally in the north-east of the Republic on the upper waters of the Rio Alto Parana. The forests are known as yerbales and they are a great source of wealth to the country. It is estimated that at the present time there are about 700 square leagues of yerbales in existence, and

most of this area is in the hands of private firms, the government owning but comparatively little. The yerbales are natural forests, and so far little effort has been put forth towards extending them by cultivation. In the days of the Jesuit missionaries in South America the plant was cultivated in the Argentine Province of Missiones and also to some extent in Paraguay, but on the expulsion of the Order their plantations fell into decay.

The yerbales are worked by native labour under European supervision, and the method adopted is that of contract work; in other words, the company agrees to supply all stores and plant required, and to take as much of the produce as can be sent down to them at a certain fixed price per 1,000 kilos. The young branches are cut from the trees and taken to a place where a drying hut has been erected. Here, under cover of a roof, they are placed on a species of wooden grid and a fire of aromatic woods kindled under them. The leaves and twigs are constantly turned over and over above this fire until they are dried and crisped. They are then thrown on to a green hide covered floor and broken up into small pieces, after which the product is very tightly rammed into bags. The next stage is the carting of the bags in bullock carts to the numerous small creeks that flow through the country, and here they are packed into native boats, which gradually find their way down to the River Paraguay and eventually into the port of Asuncion, where the grinding mill is situated.

At the factory the machinery resembles a sort of gigantic coffee mill; the bags of yerba are emptied into a large iron pan which is revolved at high speed, and the herb is ground into a more or less fine powder and falls into a chamber underneath. There then remains nothing else to be done except to pack it for the market. For the wholesale market bags are used, but for the retail trade it is put up in tins, in packets, and in other forms.

From Paraguay it is exported to almost every country in South America, but the Argentine Republic seems to take by far the greater portion of the surplus available for export. Some idea of the importance of the trade will be gained when it is stated that this surplus reaches the enormous total of five million pounds annually.

The habit of taking maté is common to the continent. In the early morning both in town and in the camp it is taken in much the same way as we take tea; in the afternoon it is the same, and often ten or a dozen times during the day the kettle is boiled to make the decoction. The method of making and taking it is as follows: A small gourd is taken and a spoonful of the herb placed in it; the gourd is then filled with water as hot as it is possible to obtain it, sugar may be added if it is desired or if it be available, but in the majority of cases it is voluntarily dispensed with; the mixture is then sucked up through a small tube called a bombilla. The cremony of taking maté is rather an ordeal, whether it be taken in a house in town or in an Indian encampment; it is the greatest compliment that can be offered to a visitor, and to refuse is to cast a slight upon your hostess. The maté is called for, and the infusion being made, the hostess first takes a sip through the bombilla, it is then passed to the guest, and he in turn after his sip passes it on to his neighbour. This may be repeated at intervals as long as the call lasts. The great art in making it is to have the water boiling and to sip it whilst very hot. It may also be infused in the same way as ordinary tea and drunk from a tea cup, but this is not the usual method nor does it improve the flavour, in fact it spoils it to many peoples' taste. The flavour of the decoction is at once bitter and astringent, but not, even at first, disagreeably so, yet no one taking it for the first time could avoid making a grimace over it. The taste is easy of acquisition, and once acquired hard indeed to get rid of. It is more seductive even than tobacco,

more alluring than strong drink, and infinitely better at once as a stimulant and a sedative than either, or both combined. And in the majority of cases it leaves no after effects to be accounted for. The peons and the gauchos employed in the country live almost entirely on meat and maté; I refer here to the natives of the Argentine Republic. If they can get their maté, even though meat be scarce or non-existent, they can carry on for a surprisingly long time and do hard laborious work on it. Without it they are simply lost. The Indians can make long journeys through desert country absolutely without food for days together, so long as their maté holds out.

Very few Europeans whose vocation calls them to South America escape the habit, and once they have mastered the flavour they prefer maté to tea or coffee. They say that they can work on it better than on tea or on anything else. The first thing in the morning the decoction is at its best; taken before daylight on a cold morning when the rain is descending in torrents and the whole world looks miserable, it imparts a sort of ruby colour to everything and forces one to take the brightest view of things. It must be understood that there is not the smallest suspicion of alcohol about it; it is simply a powerful tonic and revivifier.

I doubt if it would be possible to gain for yerba maté any measure of popularity in England. Although China tea in its early days did not spring at once into general use, this was due more to its high price than to prejudice. If the latter could be got over as regards the Paraguay tea, I am sure that there would be a great demand for it in the course of a comparatively short time. It is cheap here and could be put on the market in London at a price below that of ordinary tea.

(On the face of it the introduction of Paraguay tea into Europe looks to have the makings of a "good thing" in it, and as "good things" generally have been tried, so has this one. Up to the present, however, nothing has been achieved but failure. We have seen proof of such an attempt in this country in the shape of a tastefully got up packet of Paraguay tea, and we recollect reading of a new endeavour to popularise this article in Europe, in a journal devoted to Indian tea, some little while ago. The opinion expressed was that no headway would be made unless the financial backing for advertising, &c., was very considerable indeed.) —*The Field.*

[Every now and then attempts are made to introduce Paraguay tea, or Maté, into Europe, but so far have not met with success. The plant grows well enough at Peradeniya, but we have only one.—Ed.]

The Cultivation and Curing of Tobacco. III.

SHADE-GROWN TOBACCO.

For the purpose of testing the possibility of producing in Jamaica the expensive imported wrapper tobacco, experiments have been conducted with Sumatra tobacco under tent cloth on the lines practised in the Connecticut Valley in America. A quarter of an acre was laid out on a site occupied by Havana tobacco last year, the tent being erected over two distinct kinds of soil; one-half a very heavy soil, and the other the result of an outcrop of sandy loam or gritty loam. The plants grew equally well on both soils, reaching a height of 9 feet in forty-nine days after planting.

The results of the experiment to date show that a very fine grade of wrapper can be grown in Jamaica, equal, if not superior, to that imported from America, but to ensure correct curing, the crop must be grown in a locality a great deal

more humid than Hope. The leaves should take from sixteen to twenty days to dry, turning yellow first at the tip and upwards to the midrib, closely followed by the brown; whereas at Hope some of the pickings dried in two days, the leaves remaining a green colour. Mr. T. G. Harris thinks that it is safe to advocate the cultivation of this valuable crop only in such districts as upper Clarendon and Temple Hall. Sumatra tobacco should be grown in the ordinary tobacco season—August and September to March and April. At Hope the seeds were sown at the end ot August in seed boxes under shade; the seedlings planted out under the tent from the middle to the end of October; were weeded and moulded in the middle of November, and the first ripe leaves picked on December 12—three and a half months from the date of sowing. The tent proved to be the most expensive part of the experiment, costing £39 9s. 7d. The labour bill came to £3 8s. 3d.

Mr. T. G. Harris says that it must be remembered that in conducting an experiment of this kind, a great many difficulties have to be overcome, and in this case the only one that was beyond us was the controlling of the atmospheric conditions in the curing house during the drying of the tobacco; it was thought that adequate measures had been taken to cope with this contingent by daubing the walls of the house and fixing shutters; but the dryness of the climate was all pervading; if it is proposed to grow another crop at Hope next season, the house will have to be close-boarded and fitted with a steaming apparatus. It is my opinion, however, that nothing further is required to demonstrate that Sumatra-wrapper can be successfully grown and cured in Jamaica, provided the work be undertaken in the localities named.

JAMAICA SHADE-GROWN TOBACCO FROM SUMATRA SEED.

The experiment in the growing and curing of wrapper tobacco from Sumatra seed under shade cloth, at the Hope Experiment Station, has been successfully carried out. The texture and the elasticity of the leaf are all that can be desired, while the colour is perfect.

The cigar manufacturers who have examined the leaf pronounce it of a high quality, and the colour equal to that of imported Sumatra. The local value of the product, after being classed in the proper sizes and colours, pressed and baled, is from 4s. to 6s. per lb. A very lucrative industry is thus open for Jamaica, even although the initial cost is high.

A quarter of an acre was laid out on a site previously occupied by Havana tobacco, the tent being erected over two distinct kinds of soil; one a heavy, black loam, and the other, a sandy loam, is of a thinner and of a finer texture than that from the black loam; from the latter the leaf is heavier, and cured with a gummy substance on the surface.

In the progress of the experiment many methods were tried, and much experience has been gained, and it is not supposed that improvements cannot be made in the future. There will naturally be many ideas developed as to improvements that can be made, *e.g.*, that the plants should have been topped, the picking should have been done a little earlier or a little later to get the best results.

It is well known by all tobacco growers that different soils and different districts require different treatment. The production of the leaf, and the relation of the different soils to the character of the leaf, and the necessities of cutivation must be further studied, and this knowledge will unquestionably be beneficial.

PREPARA OF THE SEED BEDS.

No special plan was adopted in the preparation of the seed beds, the methods in common use being adopted. It is very important that in the preparation of the seed beds an ample supply of seed should be sown, provision being made by successive sowings every seven or ten days, so that when the planting season comes round the supply of plants suitable for transplanting will be ample for the purpose, and the supply should be maintained throughout the period in which the planting is to be done. After the seeds are sown, the beds should be watered, and kept continuously moist, but not too wet, until the seedlings are planted out.

On a commercial scale an ounce of seed is used for an acre of land. This ensures an abundance of plants, and in favourable seasons there will be more than enough. But it is poor economy to have scant seed beds and to wait for plants.

LAND BEST ADAPTED FOR WRAPPER LEAF.

There is no longer any question but that a sandy loam is the best, the subsoil, either clay or sand, the latter being preferable for growing leaf of the finest texture; also the climate must be warm and humid, for wrapper leaf requires a humid atmosphere from the seed to the cigar, and the reverse is deleterious. Without a proper soil, suitable climatic conditions and environments, the best results need not be expected; fine, thin wrapper leaf only is desirable, climate is essential to the growing of wrapper leaf, and as this cannot be modified by artificial means, we must seek a district where the temperature and moisture are similar to that of Sumatra—warm and humid. We have such districts in Jamaica, in Temple Hall and Upper Clarendon, where it is safe to advocate the cultivation of this valuable crop.

TIME FOR PLANTING.

Sumatra wrapper tobacco should be grown in the ordinary tobacco season, November and December to March and April. At Hope the seeds were sown on September 2, 1904, under cloth, the seedlings planted out under the tent from November 1, were moulded from November 18, and reached a height of 9 feet in fifty-eight days. The first ripe leaves were picked on January 11, 1905, 131 days from date of sowing, the average maximum temperature in the tent during the growth of the plants was 90, taken daily at 3 p.m., the minimum temperature taken at 7 a.m. daily was 66. Planting should commence not earlier than 3 o'clock in the afternoon on sunny days, but on a cloudy, light-showery day, planting should be carried on during the whole day. If there is no rain when planting begins, sufficient water must be poured into each hole, and the newly-planted seedlings should be watered every day after sunset. The plants are set out at a distance of 15 inches apart in rows 3 feet apart, running from north to south. At distances of 3 feet by 15 inches, an acre should contain 11,060 plants.

CULTIVATION.

Plants require five or six days to take root, after which cultivation should be begun and continued frequently until the plants get so large that further cultivation is liable to damage the leaves. In order to ensure rapid growth, the ground should be constantly stirred. Cultivation will stop about the time the plants begin to button. At this stage the soil is so shaded that it will not become baked and hinder the feeding of the surface roots.

HARVESTING.

When the plants are not topped they grow to the height of the tent, and the blossoms often push up the shade cloth at a height of 9 feet from the ground; suckers should be removed so as to throw the strength into the main plant. Wrapper

leaf tobacco should be primed, *i.e.*, the leaves gathered as they ripen; this needs considerable judgment and practice on the part of the grower; the leaves ought to be pulled when slight indications of a brownish colour appear round the edge of the leaf and on the tip; occasional spots will appear at other places on the surface. The ordinary indications of ripeness which govern tobacco grown in the open fields, such as yellow blotches, curling of the leaf, and the snapping of the midrib when bent, will not apply to shade-grown tobacco. By experiment at Hope it is advised to harvest the leaf at an early stage of ripeness. By going over the field in this way and picking the leaves as they ripen, the leaves are of a uniform degree of ripeness, and this is a very desirable object. At the same time there is danger in harvesting too green, as in such cases the leaf has an uneven colour when cured. If allowed to ripen fully, its texture and toughness and its delicate, pea-green hue will be spoiled.

Three or four leaves are generally taken off in the first priming; then an interval of several days will elapse before another priming can be made. It is usua to make five or six primings of a crop, which occupies a period of from five to six weeks. As the leaves are picked off the stalk they should be kept straight, placing them back to face, and laying them in baskets 36 inches by 18 inches and 12 inches deep, lined with shade cloth, with the butts to the ends of the basket, and the tips to the centre; they are carried in these baskets to the curing house. Never pick the leaves while the dew or rain-drops remain on them as spots will result. It is preferable to cut in the afternoon as the sun is getting weaker; in the forenoon unless cloudy there is a danger of sunburn.

CURING.

When the leaves are taken to the curing house thirty or forty are threaded on a string, each end of which is fastened to a lath, 4 feet to 6 inches long by ¾ inch thick. The leaves are placed on the string face to face and back to back to prevent curling; the laths are put closely in the bottom barraderas, where they may remain from forty-eight to seventy-two hours according to the moisture in the house, then carried up and adjusted on the upper barraderas, the laths put about 6 inches apart. The drying of the leaf in the curing house is entirely governed by the conditions of the weather. However, in a general way, if the house be filled with green tobacco, and the weather be hot and dry, the house should be tightly closed for about three days, by which time the tobacco will turn yellow; the house should then be opened at night and kept closed during the day; this is done to prevent rapid curing which gives a green and uneven colour. To obtain the best results, the tobacco should become fairly moist and fairly dried out once in every twenty-four hours. The opening and closing of the house require to be done with judgment, because it is by the process of allowing the tobacco to become alternately soft and dry that the leaf is properly cured. If the season during which the tobacco is being cured is excessively hot and dry, as was the case in curing this crop, means must be found to keep the house moist. In this case it was found necessary to hang cloth round the inside of the house to retain moisture; also instead of threading the leaves on string and fastening to the laths immediately on being brought into the house, the leaves were partly sweated on the floor of the curing house, spread in lots of twelve leaves one above the other, back to back, and face to face, covered with green banana leaves. If the floor of the house is made of earth, it is necessary to spread old shade cloth or bags beneath the leaves to keep them off the damp floor, otherwise the bottom leaves will get black and discoloured. Particular care must be taken not to sweat the leaves when damp with wet or moisture. Allow them to remain in this position for forty-eight hours, or until the edges of the leaves turn a yellow colour, the remainder of the leaf will also be of a slightly yellow shade; when this colour is attained, thread as previously described; put the laths on the bottom barraderas for twenty-for hours, allowing the leaves on each lath to touch one another; shut the house during the day and open at night.

Great care must be taken to prevent excessive moisture, as pole sweat, mould, or other damage to the leaf arises in that case, which must be prevented. The curing of the tobacco is completed when the midribs of the leaves are brown and soft. The time for curing the tobacco that has been primed is from twenty to twenty-two days, at which time it is ready to be fermented, or the laths may be adjusted on the top barraderas of the house, and there remain until such time as sufficient dry tobacco is ready for fermenting. To get the tobacco in condition to handle, all the doors and ventilators must be kept open during the night previous to putting into the press. The next morning the tobacco will be in what is called 'good case,' that is, it should have taken up sufficient moisture to become soft and pliable. The tobacco should contain at least 25 per cent. of moisture before being put in the bulk (press), then the process of fermentation gives the leaf a light-brown colour. If the tobacco contained 25 per cent of moisture when bulked, and the curing house be kept at a temperature of from 75 to 85 F., the tobacco will generate sufficient heat to cause a daily rise in temperature of from 8 to 10 F. For determining the temperature of the bulk of tobacco, during the process of fermentation, a thermometer was placed in the centre of the bulk. The following record of temperature (in degrees Fahrenheit) during the first fermentation process is given as follows:—April 12, tobacco put in bulk (press); 13 at 7 a.m., 80, at 3 p.m., 89; 14 at 7 a.m., 96, at 3 p.m., 102; 15 at 7 a.m., 110, at 3 p.m., 114; 16 at 7 a.m., 119, at 3 p.m., 122; 17 at 7 a.m., 125 tobacco taken out of bulk and put in a second bulk (press). The second bulk should be allowed to remain fifteen or twenty days, by which time the tobacco will have warmed up considerably, though it will not reach as high a temperature as in the first bulk. If the tobacco did not contain an overabundance of moisture when first bulked, it will be dried off by this time and the temperature will fall to about 96 or 100 F. The tobacco will now be thoroughly cured and ready for assorting and baling.

SIZING AND ASSORTING.

When the tobacco has been thoroughly cured it is ready to be sized, assorted, and baled or boxed. The sizing is the first work. The various lengths of the tobacco represent its various characteristics and types of the leaf, making five lengths from 10 to 12 inches, 11 to 14 inches, 14 to 16 inches, 16 to 18 inches, and over 18 inches. After this work is completed the assorting or shading is completed, making claro or very light-brown; colorado claro, light-brown; colorado maduro, brown, and dark-brown; and light and dark broken leaves. With the last named all leaves of uneven colour, or those which are in any way imperfect, are included. The tobacco is tied in 'hands' fanshaped of from thirty to forty leaves each; these are tied with fibre and the tobacco is ready to be baled.

COST OF GROWING TOBACCO UNDER SHADE.

Calculating on the wood-work lasting for five years, putting on new cloth each year, and including cultivation and curing, the cost of the tobacco to the grower varies from 2*s.* to 2*s.* 2½*d.* per lb.

SUN GROWN TOBACCO FROM SUMATRA SEED.

A small experiment plot was planted in the open field to test the quality of cigar wrapper leaf from out-door cultivation. A local cigar expert who examined the cured crop thinks highly of it, and was so favourably impressed by the quality that he intends growing it on a large scale. He valued the best-grade leaf at from 5s. per lb. About 10 per cent. could safely be relied on as being of first-grade leaf. The plot was planted on November 16, 1904, the first ripe leaves were picked on February 7, 1905, 159 days from date of sowing; the average maximum temperature in the shade during the growth of the plants was 86 F. taken daily at 3 p.m.; the minimum average temperature taken at 7 a.m. was 67 F. The crop was cultivated, harvested, and cured in the same manner as that grown under shade.

EFFECT OF PRIMING SUN-GROWN WRAPPER LEAF.

It was noticed in connection with this experiment that priming had a marked effect on the growth of the upper leaves, removal of the lower leaves causing an increased growth and thickness in the upper leaves, and with it an increased percentage of nicotine. The quality of the product is thus somewhat lowered, hence the small percentage of first-grade wrapper leaf. The priming of tobacco is more expensive than cutting the stalks, as more labour is required, but the improvement in quality and the percentage of high-grade wrapper leaf fully warrant this additional cost. It has the advantage that the leaves are uniformly matured when they are hung in the curing house, and the finished crop is therefore of a more uniform character.

INFLUENCE OF DISTANCE OF PLANTING ON THE YIELD AND THICKNESS OF THE LEAF.

A small experiment plot, to study the relation of distance in planting to yield and thickness of the leaf, was planted on November 16, 1904, harvested and cured in the same manner as the previous experiment. Close planting increases the yield per acre, and plants nearest together in the row produced a thinner leaf than the plants set farther apart; the size of the leaf, thickness, elasticity and size of the veins may all be more or less modified by close planting. On heavy soils, efforts should be directed to the production of a highly-flavoured leaf. These are qualities which can be sensibly affected by the distance of planting, and the time and manner of growing.

SHADE GROWN TOBACCO IN UNITED STATES AND CUBA, AND TOBACCO IN SUMATRA.

Letter from Messrs. Amory, Brown & Co., New York, to the Director of Public Gardens and Plantations, Jamaica :—The writer has been requested by Mr. R. W Lees to write you with regard to the comparative yields per acre between tobacco grown in the sun and tobacco grown under cloth in the respective cigar leaf districts. In reply I would say that I should be glad to assist you in any possible way to get at such exact information as you may desire, and shall in this letter only discuss the question in general terms. It may be laid down in a general way that the culture of tobacco under cloth makes a greater yield than sun-grown in the southern tobacco districts, and makes a smaller yield per acre than the sun-grown in the northern districts. This is due in the north to the fact that different varieties of tobacco, of less yield, are preferred for use under cloth, the product being much finer than the outdoor types that are common in these regions. In Connecticut, for instance, the outdoor tobaccos, called Connecticut Havana seed and Connecticut broad-leaf, produce from 1,600 to 2,000 lb. per acre, while Sumatra and Cuban seed, which are there preferred for planting under cloth, do not yield more than from 800 to 1,100 for Cuban and from 1,000 to 1,350 for Sumatra. This deficiency in weight is made up by the thinness and fine quality of the leaf as compared with the sun-grown.

It is due to say, however, that where the outdoor-grown seed of Connecticut tobaccos (Havana seed and broad-leaf) is grown in Connecticut under cloth, the yield per acre is usually reduced from 1,600 and 2,000 lb. to 1,250 and 1,600 lb., owing to the fact that the leaf is thinner. The capacity for covering cigars, by the pound of leaf, is, however, increased. These native tobaccos have not, as yet, been largely grown under cloth in Connecticut, the smaller-leafed types of Sumatra and Cuban being preferred. Perhaps the best comparison in Connecticut as to respective weights is shown in the case of Sumatra tobacco; small plots of this have been planted in the sun, near the cloth-covered field, and the yield per acre in the sun is much less than that under cloth, the plants not getting anything like the growth that those under cloth attain. In Florida the acreage of sun-grown is decreasing, so that it is not so much of a factor in the trade there, but there is an increase of

about 60 per cent. in the yield per acre when the same seed is planted under shade. In Cuba there is the greatest increase in the amount of wrapper obtained by the use of cloth, but as the yields are there figured in carrots and bales, the comparison is not readily obtained. Wrapper in the sun is largely dependent upon the freedom of the field from the attacks of insects. The actual weight of tobacco under cloth is there probably twice that obtained in the sun, as the plants of the same seed grow to a height of sixteen to eighteen good wrapper leaves, where outdoors they are limited to eight or ten. The same holds true of Porto Rico.

Regarding the acreage of sun-grown tobacco in these districts, concerning which, I believe, you also made inquiry, the acreage under shade has had no effect upon the acreage of sun-grown in the places named, except that in Florida there is less sun-grown than formerly. The Connecticut Valley has about 16,000 acres of cigar wrapper tobacco in the sun; Cuba, I am told, 60,000 acres or more; and Porto Rico, perhaps 10,000 acres.

As to the curing of Sumatra tobacco, the practice in the States is to prime the leaves one by one and string them upon lath, about thirty-six leaves to the lath, and the lath placed in the shed about 5 or 6 inches apart on each tier. The ventilation of the sheds depends entirely upon the weather, the idea being to get enough alternate dryness and dampening so that the cure will not be too rapid; about four to six weeks is a common period for primed Sumatra tobacco. This primed tobacco does not get the brown colour in the shed that other tobacco, harvested on the stalk, does, but many of the leaves remain a sea-green. This colour comes out in the fermentation, which is done in the bulks of about 4,000 lb., the pile being built up on a little platform, 6 feet wide by 12 feet long. The temperature in the middle of the pile is allowed to go up to about 124 F., and the tobacco is then changed around; that which was on the top and the bottom being placed in the middle, that which was on the outside being placed in the inside of the pile, which is now made up on an adjoining platform. About six to eight weeks, with a turning each week, are usually required. Assorting should be done as soon as possible, so that the tobacco, after it is sweated, will not dry out by standing before assorting; the application of water being thought not beneficial. I should be glad to answer any specific inquiries for you. The weights above discussed are of shed-cured tobacco.

It may interest you to know that information just arriving from Sumatra is to the effect that several plantations are changing from priming to curing on the stalk. This is Sumatra sun-grown tobacco.

APPENDIX I.

JAMAICA TOBACCO.

Upon the suggestion of the Imperial Commissioner of Agriculture, Mr. F. V. Chalmers visited Jamaica last year to report upon the position of the tobacco industry. The following is Mr. Chalmers' report to the Colonial Secretary :—

Generally speaking, I find the tobacco of good quality and flavour, but the majority of the leaves are of a heavy nature; consequently, from a commercial point of view, such tobacco cannot compete with other productions for the purposes of cigar wrapper in particular, and for cigar purposes generally, because, when tobacco is of a heavy nature, it is obvious that the weight of a given number of leaves is greater than when the tobacco is of a finer texture. This is a most important point when competing with a country like Great Britain, where the duty is very high. The quality of the tobacco, that is to say, the flavour of aroma, is in nearly every instance excellent.

TOBACCO SOILS.

The foregoing remarks apply to the great proportion of the tobacco now being produced, but I think if more attention were given to the soils upon which this tobacco is grown, so that it was made of lighter nature, a finer and a lighter tobacco from every point of view might be produced. It must always be remembered that tobacco cannot be produced or determined by a chemical analysis. The quality of some vegetable productions is largely decided by a determination of its starch, such as the potato or maize, and other percentages, but the quality of tobacco appears to be determined only by the senses of man ; colour, texture, aroma, and combustibility are the points by which the quality of tobacco is estimated. Organic and inorganic salts seem to have considerable effect on these qualities. The organic compounds seem to bear a closer relation to the aroma of the tobacco, while on the inorganic salts depends largely the combustibility. A large proportion of potash in the tobacco improves the burning, and when potash is present in the form of a carbonate, the best results are obtained. The growers of bright tobacco find that the tobacco grown on land immediately after the ploughing under a leguminous crop is deficient in texture and colour. The bright tobacco planters frequently allow their land to grow up to grass and weeds for a year, and plough this under that they may have the land in the best condition for a fine crop ; but this is a system applied to the production of American tobacco, namely, Virginia, which is of a strong nature and might not apply for the production of a fine cigar leaf, but the value of wood-ashes as a rule can be safely relied upon as a good expedient.

SHADE-GROWN TOBACCO.

I now come to the shade-grown tobacco which has been produced at Hope Gardens, and I am pleased to be able to report that, with one or two objections in the leaf, the product has every appearance when perfected of being a type of tobacco which is hardly likely for the purpose of cigar manufacturing, principally from a wrapper point of view, to be excelled by any other tobacco of the world, and from the estimate prepared by the Hon. W. Fawcett of the cost of such production, in my opinion a very lucrative industry should arise in Jamaica. But let me clearly say that the tobacco must be produced in a thin, good colour, that is to say, a light, level colour, free from spots and of a strong texture ; and last, but by no means least, a positive knowledge as to fermentation must be applied, or the whole proceeding will be a failure, because two fatal conditions will arise, viz., the flavour or aroma of the tobacco will not be perfect, and the tobacco will be tender, and, on account of its extreme thinness, very liable to break and consequently would be useless as a cigar wrapper.

Tobacco that is essentially grown for the purpose of wrapper is in nearly every instance the least good for any other part of a cigar ; and, furthermore, to produce a fine cigar wrapper, such as I firmly believe can be produced in Jamaica, would present a competitive quality only to be found in the very picked of Cuban productions, viz., it will contain a delicious flavour, which should make it very valuable indeed, more especially as it is universally admitted that at the present time there was never so much tobacco, and it was never so bad. This remark applies in particular to the whole product of Havana.

PIPE TOBACCO.

Hitherto, as far as my experience goes, the tobacco of Jamaica has never been used as a pipe tobacco, but, having regard to the great depreciation of American tobaccos generally, and the general desire of smokers for a mixture or blend of tobaccos of varying flavours, I see no reason why this excellent tobacco, though of a thick nature, should not form one of the ingredients in such mixtures for the pipe. With that end in view it is my intention to bring the matter before some of the manufacturers of Great Britain.

Extract from a letter from the Director of the Imperial Institute to the Under-Secretary of State for the Colonies, dated December 20, 1904 :—

The trade report made by Mr. Chalmers on the tobacco of Jamaica is of considerable interest. The fact is already appreciated in this country that Jamaica is able to produce cigars of excellent quality. The quality does not, however, appear to be uniform. The subject is so important that no effort should be spared to take whatever steps are needed for the development of the industry. If the recommendations made by Mr. Chalmers in his report are to be followed, it would seem highly desirable to obtain expert advice with reference to the cultivation, picking, fermentation, and curing of tobacco suitable for the manufacture of cigars. This assistance could best be obtained from Cuba, or from Sumatra or Florida, where suitable varieties of tobacco are successfully produced.

This step has been recently taken in connection with the development of the tobacco industry in South Africa and also in Ireland.

Extract from a letter from the Board of Trade, Commercial Department (Intelligence Branch) to the Colonial Secretary, Jamaica, dated December 7, 1904 :—

In the report from the expert, referred to above, interesting information is (as you are aware) given, embodying the results of his inquiries and investigations into the growing of tobacco in your colony, and the possibility of the establishment of a very lucrative industry in connection therewith; and there is no doubt that the particulars contained in this report would be of considerable interest to the representatives of the tobacco trade in this country. The value, however, of the information given would be materially enhanced if the report itself were accompanied by samples of the various grades of tobacco produced, and such samples (if produced) could be exhibited at the offices of this branch in illustration of Mr. Chalmers' report, and could be retained here for examination by tobacco importers in this country, and afterwards sent to the Imperial Institute, or otherwise disposed of as might be directed. I should be glad, therefore, if arrangements could be made for samples of such tobacco to be forwarded to this branch for the purpose indicated.

Extract from a Minute from the Director of Public Gardens and Plantations to the Colonial Secretary, Jamaica :—Professor Dunstan states that Jamaica cigars are of uniform quality. This fact is due to the trade being at present of only small dimensions, and there is no doubt that the quality will gradually become uniform as larger stocks of tobacco are used for an increased trade. Expert advice would be of great assistance, as Professor Dunstan suggests, especially as to Sumatra tobacco, when it is possible for the Government to spare the necessary money. The Department has, however, studied the problems of cultivation and curing with the help of trained Cubans, and has a practical school at Hope Gardens, where any one is welcome to come and learn, and where the apprentices are taught during their time of service.

I have sent samples of tobacco to Mr. Worthington, of the Intelligence Branch of the Board of Trade, but I do not think that it is possible to do much at present in an export trade of leaf tobacco. The samples should not, therefore, be put forward as soliciting orders, but only as indicating what Jamaica can produce. All that is now grown is required for the cigar business, which is gradually growing, but large orders might lend again to a catastrophe in our trade. We should aim rather at quality than quantity.

Extract from a letter from the Director of the Imperial Institute to the Director of Public Gardens and Plantations, Jamaica, dated March 30, 1905 :— I have received through the Colonial Office a copy of a memorandum prepared by you with reference to certain suggestions made by me in a letter, dated

December 20, 1904, to the Under-Secretary of State for the Colonies, as to the steps to be taken to improve the quality of the tobacco produced in Jamaica. I also venture to suggest that it would be well if typical samples of the tobacco grown in Jamaica, and of products such as cigars or pipe tobaccos manufactured from them, could be sent here for exhibition in the Jamaica Court of the Imperial Institute.

The samples should be accompanied by statistics of production and export, and information as to the prices at which products of similar quality could be delivered in this country, so that descriptive labels for the exhibits may be prepared, and that we may be in a position to answer any inquiries received from merchants and others to whose notice the exhibits will be brought. The Imperial Institute has paid special attention to the question of tobacco cultivation and examination, and would be ready to give any assistance in connection with this industry in Jamaica.

APPENDIX II.

JAMAICA TOBACCO FOR THE NAVY.

In a letter addressed to the Under-Secretary of State for the Colonies, dated October 21, 1905, the Secretary to the Admiralty states that, with the assistance of Mr. F. V. Chalmers, the Admiralty obtained a supply (1,508 lb.) of leaf tobacco from Jamaica, but, as it transpired that this tobacco by itself was not suitable for pipe smoking, and that there is not, at the present time, any colonial-grown tobacco suitable for blending with it, arrangements were made for it to be blended and manufactured with a quantity of Virginian-grown tobacco, the proportion being 1,508 lb. of Jamaican to 5,075 lb. of Virginian. This preparation is now undergoing trial in the fleet, and the results of the experiment will be communicated in due course. It is hoped that, should this preparation meet with the approval of the sailors, a great impetus will be given to tobacco growing in the West Indies.—*Imperial Department of Agriculture for the West Indies; Issued by the Commissioner.*

Tobacco Cultivation in Jaffna.

By A. Charavanamuttu.

I purpose in this paper to describe the process of cultivation of tobacco in Jaffna with a view to ascertain what improvements can be effected in it and in what manner the Agricultural Society can help the cultivators. Tobacco is extensively cultivated in almost all parts of Jaffna in what are known as "garden lands" or high lands, and also in low lying paddy fields immediately after the harvest. Next to paddy cultivation, tobacco cultivation is the main industry of the people of Jaffna, and it is worth careful study.

The cultivation of tobacco begins about the end of October and continues till the end of April. First, tobacco seeds are sown in nurseries. A 'nursery' consists of a small plot of ground, a warm sunny spot chosen in the garden and raised a foot high from the surrounding earth. Leaves are buried in it a foot deep, and over it cattle or goats' dung is spread in abundance and the soil turned with the hoe and with the hand, and the process repeated several times until the soil is reduced to a fine powdery condition, so that when it is taken in the hand and squeezed will readily fall down loose like sand. The ground is then levelled and beds marked in it 3 to 4 feet wide, and of the same or of greater lengths according to the quantity of seeds that may be sown.

The seeds are very small, smaller than the mustard. They are usually mixed with ashes or fine sand, one part of seeds to two parts of sand being a good proportion, and are sown thinly scattered over the beds. They are then mixed with the upper layer of the soil and pressed down with the hand. Water is gently sprinkled over the beds, which are then covered with coconut or other leaves to protect them from the hot sun. If the weather is very dry, the beds are carefully sprinkled with water twice and thrice a day for 8 or 10 days until the seeds spring forth. Now the cultivators take good care to let the seedlings have as much light and air as possible. They remove the leaves spread over the beds and erect what is called a 'pandal' which consists of small sticks or posts planted 4 feet apart all round the edges and 2 or 3 feet high to which light sticks are fastened along and across. Over this palmyrah olas or cadjans are spread and thatched in order to protect the seedlings from the hot sun and heavy rains. During dull weather and slight drizzling rain the 'pandal' or shelter is removed, as the cultivators consider it more beneficial to the seedlings than artificial watering.

If the seedlings be too numerous or too close to one another, new beds are prepared as before close by, to which some of the crowded seedlings are removed and temporarily transplanted and sheltered as before. In about two months they will be fit for transplanting into gardens which are prepared for the purpose.

The seedlings are sometimes affected with a kind of disease commonly called "karuntadi." The disease manifests itself in the stem of the young plant near the root. The stem looks black at the bottom and the root decays underground, but the freshness and greenness of the tender leaves remain unchanged until the whole root decays and the young plant withers and dies. There is so far no known remedy to prevent or arrest the progress of this disease, and I am not aware that any scientific investigation has ever been made regarding it.

GARDENS.—In Jaffna, except lands where tobacco is annually grown, all land newly brought under cultivation is more or less stony soil. Huge blocks of hard stone are dug out of the earth at considerable expense of time and labour. A well is sunk 30 to 40 feet deep at a cost of from Rs. 300 to Rs. 500. The land is then tilled, manured and prepared in the same manner as other garden lands are prepared annually. Unlike lands in the Vanni, lands in Jaffna have almost exhausted their fertility by continuous production of different crops on the same soil all the year round. They therefore require careful manuring every time products are cultivated.

In October the cultivator begins to pen his cattle in the gardens. Generally four animals are joined by means of ropes to the four legs or posts of a 'toddil' or a movable wooden hut with a 'kudil' or round roof like a large umbrella. The 'toddil' contains fodder for the cattle and the 'kudil' shelters them from sun and rain. They are moved from place to place until the whole garden is manured. Breeding of cattle is an important factor in cultivation. They supply the best manure procurable. The cultivator prefers tethering and penning cattle to manuring his gardens merely with their dung. If he owns no cattle, he borrows them from other persons who do no cultivation.

When the garden has been manured in this manner, the land is hoed and ploughed three or four times and green leaves are buried a foot deep. Punku, Pannai, Pávaddai, Nāval, Guava, Manchavanná, Margosa, and Púvarasu leaves are employed for the purpose, several cartloads and boatloads being brought over from the Pachchilapaly and Punaryn divisions during the cultivation season. The Kávilai, Bot. *Tephrosia purpurea*, a leguminous plant commonly grown in gardens and compounds, and the 'Sivanār-Vembu,' Bot. *Indigofera aspalathoides*, another plant growing wild in the high chempádu lands of the peninsula, are both accepted

as the best manure for tobacco, as are the leaves of the tamarind, margosa and palmyrah found to be best suited for paddy, and arukkalai, avarai and pavaddai leaves for onions. After the leaves have been buried cattle are penned a second time, or goats and sheep similarly employed, or merely cattle dung is spread over the soil, which is then turned with the hoe and levelled and made ready for transplanting the seedlings. The above process of preparation commences about the end of October and continues till the end of December. Early in January the seedlings are removed from the nursery and planted in the garden in small holes three feet apart. The young plants are covered with small boughs of trees containing clusters of leaves as a protection against the hot sun. The plants are watered once and twice a day as may be necessary. After two or three weeks the shelters of leaves are removed and furrows or channels are made at convenient distances between the plants with smaller furrows leading to the root of the plant, by means of which water is led to the plant from a channel starting from the mouth of the well, without wetting the intervening spaces between the plants. Cattle dung is again spread over the ground, or goats and sheep penned among the young plants for manuring. Two young palmyrah olas are tied round each plant which is within the sheep pen to protect it from injury during night. The olas are removed next morning soon after the goats or sheep have been, let out in the plains to graze Every day the manured portion is tilled and weeded, and earth raised round each plant forming small squares enclosing four plants in each, so as to form small reservoirs into which water is conveyed every other day.

The means of irrigation in Jaffna is entirely from wells at depths varying between 20 and 40 feet, from which water is raised by means of ola baskets worked with a well sweep. One person is at the mouth of the well letting down the basket and lifting water in it, a second person, and not infrequently a third man also, on the well sweep helping the first to raise the water, while a fourth person conducts the water to each reservoir and plant. In the manner plantations are watered in the Jaffna peninsula, the work cannot be done by a less number. Three persons at least should form a company to work. But in some villages of Punaryn, Pachchilapaly and Vadamaradchi East, whose sandy soil is not suited for irrigation by means of channels, there are water holes dug, called 'thuravús' in which men take their vessels, fill them with water and empty it at the root of the plant. By this mode of irrigation one or two men may carry on the cultivation of tobacco, but it is on a limited scale. The young plants are stunted in growth and their leaves are smaller than those grown in other divisions where the plants have an abundant supply of water by means of channels. Nothing better can be done in a sandy soil, and the cultivator toils hard and does his best to get anything he can from it. The young plants begin to blossom in March, and then the top portion is lopped off leaving about twelve leaves on the stem. Any off-shoots which appear on the stem are carefully removed at once. If the top is not lopped and the blossom allowed to mature and form seeds, the leaves at the bottom will wither and fall, the middle leaves will not lay out well but get smaller and thinner. If the top is lopped off, in about 60 or 70 days the leaves will have grown to their full size and maturity. According to their quality the leaves when cut are separated into four kinds, viz., 1st called 'Thiram' or best kind which consists generally of the fully matured middle leaves, five in number; second sort called 'Kochchi' next below in quality; two or three leaves to a third sort called 'Idai' or middling sort, also two or three leaves to a plant; fourth and the last sort called 'Sachchu' which consists of the two leaves at the bottom of the plant. These are of inferior quality to all others. There are some persons who separate the leaves into three classes only called 'Kali,' Galle sort; 'Kochchi,' Cochin sort; 'Gampolai,' Gampola sort, named after the places to which the leaves are transported for sale.

(*To be continued.*)

PLANT SANITATION.

Entomological Notes.

By E. Ernest Green, *Government Entomologist.*

Specimens of tea leaves, attacked by the 'Ribbed Mite' (*Phytoptus carinatus*) and the 'Yellow Mite' (*Tarsonymus translucens*) have been received from several correspondents. Both these pests are readily amenable to the sulphur treatment.

Another small outbreak of the 'Morawak-korale Nettle Grub' (*Thosea recta*) has been reported from tea in the Yatiyantota district, but the pest has been kept in hand by prompt measures (the collection and destruction of the caterpillars).

The 'Red Slug' (*Heterusia cingala*) has put in an appearance on tea in the Norwood district.

Signs of 'Tortrix' (*Capua coffearia*) have been observed in the Yatiyantota district, but this pest does not seem to thrive at low elevations.

I have reports of injury to the foliage of Cacao plants, in the Kurunegala district, by a small species of Thrips (*Physopus rubrocincta*, Giard) which infests the under surface of the leaves. The consequent fall of leaf interferes with the proper ripening of the crop. Sulphur (as recommended for tea mites) will be found a useful application.

Examples of the large caterpillar of the 'Death's Head Moth' (*Acherontia lachesis*) have attracted attention by defoliating young plants of 'Dadap' (*Erythrina*). The caterpillars can be easily collected and destroyed by hand.

The annual invasion of bungalows by the small hairy caterpillars of *Azura* (*Nepita*) *conferta* has commenced. They have an inconvenient habit of concealing themselves in hats, clothing and towels hung up to air. Such articles should be examined and well shaken before being used. The resulting moths may now be observed on the wing. They are of a dull orange colour, the wings barred with black.

A somewhat alarming caterpillar pest of cinnamon is reported from the Moratuwa district. About 40 acres are infested. A similar outbreak is said to have occurred about two years ago when slaked lime was applied without success. It was subsequently found necessary to cut down and burn the whole of the infected cinnamon. If Paris Green had been mixed with the lime, in the proportion of one part to six by weight (equal to about one to ten by measure), the loss of the cinnamon might have been avoided. Arsenical preparations are the only effective remedy for leaf-eating caterpillars.

The caterpillar in question proves to be that of a common moth (*Euproctis fraterna*, Moore). It is of a dull brown colour, with a crimson head; there are short tufts of ochreous brown hair on the back, and longer greyish hairs on the side of the body. The resulting moth measures from one to one-and-a-half inches across the expanded wings which are of a bright yellow colour with some indistinct darker bars and three small black spots on the outer margin. The caterpillar is practically omnivorous and is widely spread, but does not usually appear in troublesome numbers. It is probably kept in check by Ichneumon flies, under ordinary circumstances.

I have been experimenting with a patent insecticide brought out by the well-known Strawson's Co, (and supplied by their local agents in Colombo). It is sold under the name of 'Vaporite,' and is designed for use against all subterranean

insects. It can be ploughed into the soil, mixed with the earth in holes prepared for planting, or dibbled into the soil around growing plants. It is said to slowly give off a noxious gas which kills the insects without injuring the plants. That it will kill subterranean insects, I have proved to my satisfaction, but my experiments are too recent to show its effect upon the plants.

We have—in the Cockchafer grub—a very troublesome pest of young rubber plants. I have a report of over 3,000 plants being killed by this pest in a single small clearing. I procured a number of healthy living specimens of the grubs for the purpose of experiment. A few of these grubs were introduced into a series of pots containing growing *Hevea* plants. The soil in half the number was treated with 'Vaporite' (1 oz. to each pot), the remainder being left untreated as a control. Within a few hours the grubs in the treated pots had come to the surface, showing signs of distress. Twenty-four hours later, these grubs were all dead, while those in the untreated pots remained below the soil—presumably in good condition. A number of the grubs were placed in each of two biscuit tins filled with loose soil. An ounce of 'Vaporite' was mixed with the soil in one of the tins while the other was untreated. Examination after forty-eight hours showed the grubs in the one tin to be quite dead, those in the other tin remaining healthy and active. This mixture therefore would seem to be of real value against cockchafer grub and other subterranean insects. It should be particularly useful for preventing the attacks of cut-worms in vegetable gardens, and might be tried in cases of gall-worms (Nematodes) on the roots of plants. Its employment is suggested against wire-worms, millepedes, and against the bulb-borer of the cardamom plant.

LIVE STOCK.

Poultry Notes.

By G. W. Sturgess, M.R.C.V.S.

DISEASES OF POULTRY.

Debility or Weakness.—Weakness and anaemia are usually due to close confinement, want of proper food, air, and exercise.

Proper attention to these points usually puts matters right. Such tonics as Parrish's food, Sulphate of Iron and a small allowance of raw lean meat or blood mixed with meal will cause the birds to improve.

Diarrhoea.—Diarrhoea may be due to sudden changes of food, or too much of a particular kind of food, or to impure drinking water, or exposure to cold and wet.

Symptoms.—Frequent passing of liquid faeces which may be mixed with mucus and smell badly. The feathers around the vent are wet and dirty. When in this state flies frequently deposit eggs, and maggots form, causing nasty sores.

Treatment.—The cause should be looked for and removed. The food must be given fairly dry and in moderate quantity. It is important to provide a proper supply of green food. Fresh pure water is absolutely necessary in limited quantity. At first a dose of salad oil or Butter or Epsom salts may be given followed by pills composed of small doses of Camphor, Opium, Chalk and Dover's Powder. Five or ten drops of Chlorodyne in a little water may be given two or three times a day. If the diarrhoea persists two or three grains of Bismuth Subnitrate may be added to the pills. The native remedy is powdered chalk and saffron.

After the purging ceases the food must be carefully regulated for some days, and should be soft and easily digested with a fair allowance of green food.

Dysentery.—Cases of ordinary diarrhoea may develop into dysentery, and blood and mucus is passed in the faeces.

Treatment.— A dose of Epsom salts should be given followed by the treatment mentioned for diarrhoea. Great care must be taken with the food for some days. It may consist of a little boiled rice and bread damped with milk or arrowroot or soup and green food. A few spoonfuls of arrowroot jelly to which is added a few drops of Chlorodyne may be given daily.

Diptheria.—(Avian.) There is probably two forms of diphtheritic inflammation in fowls, one caused by bacteria, a much dreaded and contagious form; the second caused by parasites (Gregarines) which is probably the most common in Ceylon. The disease in poultry is not thought to have any connection with human diphtheria. Advanced cases of "Roup" are most likely of a diphtheritic nature. "Canker" is also commonly used in connection with diphtheritic diseases in poultry.

Symptoms.—At first the general health is not much disturbed. If the mouth is opened and the throat examined there may be well developed patches of disease recognised by a yellowish white membranous growth on the mucus membrane of the throat before the bird seems very ill.

As the disease advances the bird is off its feed-feathers ruffed, wings drooped and is feverish. If the beak is opened the yellowish white patches are easily seen on the palate and palatial cleft.

The disease may spread to the angles of the mouth, nostrils, face, and eyes There may be a swelling at the base of the beak which, if pressed, causes discharge from the nostrils. When the eyes become diseased there is a discharge, the eyelids stick together and are swollen. If pulled open a serous or mucopurulent fluid escapes. The eye may become ulcerated and completely destroyed.

The intestines may become affected, when foetid diarrhoea, dullness and stupor follow. The disease may assume an acute or chronic form, the former killing in 5 or 10 days and the latter in several weeks.

In acute cases the symptoms mentioned are present in a very aggravated orm, and there is diarrhoea and collapse. In chronic cases the membranous growths are present in the mouth, and there is gradual emaciation, anaemic diarrhoea and death.

(To be continued.)

POULTRY KEEPING: A PRACTICAL STUDY OF EGGS.

Although eggs are a common article of food there is not a general knowledge amongst poultrymen as to their formation. Thus the shell is composed of carbonate of lime, phospate of lime, and animal gluten; salts of lime causing the particles to adhere. Soft eggs are either eggs without a shell, or the shell may be so thin as to feel soft through the deficiency of salts of lime. It is a matter of surprise where the hen finds all the lime necessary, for if she lays 150 normal-sized eggs in the year, she will have produced two pounds of pure carbonate of lime.

Hens are wonderful chalk makers. Mr. P. L. Simmonds, on this subject in the Journal of the Society of Arts, says:—"If a farmer has a flock of 100 hens, they produce in egg shells about 137 pounds of chalk annually, and yet not a pound of the substance, or perhaps not even an ounce, may be found on the farm. The materials for the manufacture are found in the food consumed, and in sand, pebbles, brickdust, pieces of bone, etc., which hens and other birds are continually picking from the earth. Their instinct is keen for these apparently innutritious and refractory substances, and they are devoured with as eager a relish as the cereal grains or insects."

If hens are confined to barns or outbuildings, it is obvious that the egg-producing machinery cannot be kept long in action, unless materials for the shell are supplied in ample abundance. If fowls are confined in a room and fed with any of the cereal grains, excluding all sand, dust or earthy matter, they will go on for a time, and lay eggs, each one having a perfect shell made up of the same calcareous elements, but only for a time.

The shell is a "sieve." The shell is porous to such an extent that when examined by a microscope it has quite a sieve-like appearance, and is permeable by the air, otherwise the chicken could not live during the incubating period. This porosity of the shell, although absolutely necessary when the eggs are to be incubated, is detrimental when such have to be used as an article of food, from the fact that by means of these minute perforations there is a continual evaporation, so that from the time the eggs are laid until consumed there is a wasting and deterioration of the contents, the extent of which is dependent on the temperature and other conditions under which they are kept, it being very well known that eggs deteriorate much quicker in summer than in winter.

FORMATION AND PRODUCTION OF AN EGG.—Anyone, upon opening after death the body of a hen, will find a cluster of eggs in formation much like a bunch of grapes, and called the ovarium. These, however, are but rudimentary eggs,

and I have counted as many as seventy in one bunch, and are in size from a pin's head to the full-sized yolk of an egg. Each of these eggs is contained within a thin transparent sac and attached by a narrow pipe or stem to the ovary, and during the laying period of the hen these eggs are maturing and thus keeping up the supply which she lays. These rudimentary eggs have neither shell nor white, consisting wholly of yolk, in which floats the germ of the future chicken; and as they become larger and larger they arrive at a certain stage when, by their own volition, weight, or other cause, they become individually detached from the bunch and fall into a sort of funnel leading into a pipe or passage called the oviduct--this organ in the hen being from 22 to 26 inches long.

THE COATING OF ALBUMEN.—During the passage of this egg or ovum to the outer world it becomes coated with successive layers of albumen—the white—which is secreted from the blood-vessels of the oviduct in the form of a thick glairy fluid, and is prevented from mixing with the yolk by the membrane or sac which surrounded it before it became detached from the cluster. It is also strengthened by a second and stronger membrane, formed around the first immediately after falling into the funnel, and having what is like two twisted cords of a more dense albuminous character, called by anatomists chalazes, which pass quite through the white at the ends, and being, as it were, embedded therein, thus preventing the yolk and germ from rolling about when the egg is moved, and serving to keep the germ uppermost, so that it may best receive the heat imparted during incubation.

It is during the passage of the egg through the lower part of the oviduct that it gets covered with the two skins which are found inside the shell. These although lying close around the egg, at the thick end become separate, and form what is called the air-bubble or chamber. This, in newly-laid eggs, is a mere speck, and is that portion which shows the result of the evaporation previously referred to. This speck of air space becomes daily larger as the egg gets older, and is frequently equal to one-fourth of the entire egg. The egg-chamber, if perforated with the finest needle, will prevent the egg hatching. When the egg has advanced more than half-way down the oviduct, it is still destitute of shell, which begins to be formed by a process of secretion, and when about completed the various shades of brown and tinted coloring matter are imparted in those breeds in which colored eggs are peculiar; sometimes in very brown eggs white spots appear, but which can readily be rubbed off. When the shell and coloring are complete the egg continues to advance along the oviduct till the hen goes to the nest and lays it.

Crooked eggs are no uncommon thing in the poultry yard, and are attributable as follows:—Twenty-four hours are usually sufficient for the formation of a perfect shell, but when by stimulation a second ovum falls close on its predecessor, reaching it before laid, the second egg, which is up to this time soft and is lying against the hard one, becomes covered with a shell, and when laid presents a flat or grooved side, the result of its position against the hard one.

Eggs are produced from the surplus food, which is that over and above what is required for the sustenance of the hen, and, if such is too stimulating, or given in excessive quantities, the result is that in the former case the ova are produced so rapidly that sometimes two of them drop into the oviduct together, which results in the eccentricities which frequently puzzle the poultry keeper. These ova travel together along the passage and receive separately, but become enveloped in one shell, and when laid are commonly known as double-yolked eggs, but more properly it is a double egg, the white being duplicated as well as the yolk. Should these yolks be fertilized and the egg hatched, we get the occasional four-legged or other chicken monstrosities.

A further result of stimulating food is varied from the above when the ova mature in excess of one a day. In place of falling into the passage in pairs, as above, the two drop in separately but on the same day. This results in soft eggs, not from the want of shell-forming material, but rather because the shells cannot be formed as fast as the mature egg is ready for such covering.

To over-feeding is also attributable the further irregularity of one perfect egg being found within another, and caused by irritation of the oviduct, which contracting in front of the perfectly-formed egg instead of behind it, forces it back until it meets another yolk, when the two join and again become coated with the white and the shell, thus producing another wonder. Other abnormalities are occasionally seen, and particularly in the smaller poultry yards. Sometimes when the ova are nearly exhausted by continuous laying, the secreting organs may be most active, which results in small marble-sized but perfect-looking eggs, which are merely a shell covering a portion of albumen. Such "eggs" when laid have the peculiarity of not having been at any stage attached to the ovary, but are a product only of the oviduct.

To the internal fatness of the hen are due other eccentricities than those mentioned, including the apparently paradoxical feat of laying rotten new-laid eggs, this being a not infrequent occurrence. The egg, being unable to force its way through the fatty oviduct, is retained two or three days near the mouth of this organ, and, if a fertilized one, the heat of the hen's body tends to putrefy it, and when ultimately laid it is in an addled condition. To other causes, but principally diseased organs, is due a departure from the normal in the way of colour. A hen which lays white or brown eggs, on rare occasions produces one almost black, while at other times these vagaries much resemble the dark green of the emu's eggs, and, in most instances, the shells are rough, wavy, corrugated, or otherwise irregular. Then there are instances of foreign matter being found in eggs, clots of blood beingnothing unusual. This is the result of the breaking of a blood-vessel internally.

Fowls from whatever cause producing any of the above misshappen or otherwise faulty eggs should at one be got rid of, for although in some cases a reduced diet may bring them back to their normal production, still the slightest cause will frequently prompt the organs to their previous irregularities, the fowls thus becoming unprofitable members of the flock. As has been seen the majority of troubles mentioned are preventable ones, and largely due to the poultry keeper's mistaken kindness of over feeding.—*Garden and Field.*

Brandmarks on Kandyan Cattle.

By T. B. Pohath-Kehelpannala.

The ancient brandmarks of the cattle* belonging to the Kandyans were generally symbolical of the distinctive caste, village, or family to which the owner belonged. With respect to caste, the mark usually took the shape of some instrument or article characteristic of the profession or occupation followed by the people of the caste to which the owner of the cattle belonged.†

In regard to village, there were certain especial marks which indicated that the owner of the cattle belonged to a particular village. Some villages had their peculiar distinguishing marks. All residents of a particular village were entitled to brand their cattle with the mark indicative of that village, irrespective of caste In older days, in addition to the village mark, the initial letter of the name of the owner was also branded.

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* This includes buffaloes also.

† In Gangaboda Pattu, Galle, the brand for the Gowigama-Sinhalese is an ear of paddy.

In the case of families, some Kandyan Chiefs, as will be instanced later, generally had their own private marks indicative of a particular family, and the cattle belonging to any member of a particular family were branded with the mark of that family. Even at the present day, the branding of cattle according to the old system is carried on to a great extent in some districts, but in others it is gradually dying out. Where cattle are now branded with the caste or village marks, one generally finds in addition the initial letters of the names of the *village*, *gename*, and the *owner*. It is obvious that the combination of all these marks is highly desirable, so far as identification of cattle are concerned, as it also reduces to a minimum the possibility of cattle thefts so prevalent now in the country. The use of the caste-mark would effectually prevent cattle belonging to one caste from being stolen by another. At first glance anybody will be able to identify cattle belonging to a particular class or village by the brands, and nobody would venture to brand his cattle with a different brand than that of his own.

The Kandyans, I may say, do not in the least bit view the matter of "*Jamma Nivarana*" caste brands, as they are called in Matale, in the light of any invidious distinctions of caste, but they welcome it, in every way, as an effective precaution. Cattle, among the Kandyans, constitute a very valuable portion of their possessions. They play an important part in agriculture, and even form a dowry-share in Kandyan matrimony. This being so, the advisability of encouraging and preserving the old custom established from time immemorial of branding cattle according to distinctive marks needs no argument in its favour.

The brandmarks are made by impressing them with a redhot iron called a "Suttukole,"* which is a piece of iron about one and a half inches in length, bent into a curve at the end. The branding is done in the fore or afternoon at some hour which is considered auspicious. A dilution of salt, ashes, cowdung or turmeric, or an oleagenous mixture of ant-hill clay and burnt straw ashes or oil, are generally rubbed over the hot impressions in order to prevent suppuration and to allay the pain which may be caused by the application of the hot iron. Sometimes the impressions made by the hot iron delay healing and generate pus-forming sores. A general remedy in such a case is the application of a mixture of burnt *domba* (*Calophyllum inophyllum*) fruits, ground with *Kekuna* (*Canarium balsamiferum*) oil.

The branding† of cattle is considered to cause very little pain to the animal. On the other hand, it is thought by those competent to express an opinion, that the branding of cattle with a red-hot iron, tends to improve the condition and preserve the health of the animals, hence the practice of some low-country Sinhalese people branding their cart-bulls with elaborate ornamental marks.‡

CASTE BRANDS.

In Matale North, for the *Haquro*§ (jaggery caste people) the *Totiya Pahimbuwa*; the Porokarayo (wood-cutters) the *axe*; the Etolayo (elephant-keepers) the *Henduwa*, the elephant's crook; the Oliyo,¶ (dancers) the sieve (*kulla*); the Hannali (tailors) the *Buletpaiya*, the betel-bag; the Patti Wala Aya, (people who belong to the royal palanquin department) the *Kunamyate*; the Kinnarayo,** the *Nadawa*; the Embettayo, the scissors.

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* Also called *Angurukokka*.

† Called in Sinhalese Nivaranakaranawa or Hanvadu Tiyanawa.

‡ In addition to the administration of internal decoctions, different symbols representing peculiar diagrams of a mystical or astrological character are branded on the animals in order to cure various diseases.

§ Sometimes they brand the *Mauné* a cutting instrument.

¶ These people in some villages of Matale brand the *Ada Taliya*.

** This class brand also the *Pedura*, the mat.

In Matale district, for the Paduwo, the brand is the *Bo-Kole* (Bo-leaf); the *Hunno* (chunam-burners), the *Hunupatta*; the Veddho, the bow; the Rodiyo, the *Varapota*, a string; the Pannayo, the sickle.

In Gampola and other districts, for the Achari (Blacksmiths), the *Abarana Aduwa*; the Henayo, (the dhoby), *gala* the-stone; the Paduwo the *Batgam Alla*; the Badalo (the Goldsmiths), the *Aduwa*; the Berawayo (Tom-tom-beaters), the *Daul-Kadippuwa*, or the *Taliya*, the gong; the Paliyo, the *Kanda*, a log of wood.

DISTRICT OR VILLAGE MARKS.

For Galboda Korle, Kegalle, the *Tanirohotiya*; for the village Kanangomuwa in Matale, the *Koku Pahimbuwa*; for Kotmale, the *kota*, the spire at the top of buildings; the Four Korles, (Kegalle district) for Korale villages, the *Irattipure*; Three Korles, for Kandyans of rank, the *Pahimbu*; the Kandyan Moors, the *Gamajadiya*.

For the Gabadagan (royal villages of Gampola) the *Nelun Mal Pahimbuwa*; villages of Unambuwa, Kirinda and Udowite in Gampola, the *Kerallama;* the villages of a Devale, the *Sulama;* the villages in a Vihare, *Agultattuwa;* Dolosbage District, the *Bopate Pahimbuwa;* village of Angammana, the Tamil letter, *Ayanna* royal village of Naranwita, the *Iratti Nelun Malpahimbuwa;* Tumpane the *Nelum Mala*, lotus flowers; Alutnuwara* the *dunna* (bow) and *Nelum Mala* (lotus flower.)

BRANDS OF SOME KANDYAN CHIEFS.

For the Dullweve, Veragama, Hulangomwe families, the *Era-Handa* Sun and Moon; the Alutgama family in Matale, the *Nelum-Mala* (lotus flower) and *Ada-Handa*; the Dorakumbure family, the *Torana pahimbuwa;* the Aluwihares, *Mediyama*; the Pata Bulutgama, the *Binduwa*, a drop.

With regard to the brand-marks on cattle, the Hon'ble F. R. Elllis, C.M.G., late Auditor-General, wrote me the following on May 7th, 1906:—

"Under the new branding system the only brand that will be compulsory will be the communal brand. It will be left optional with the owners of cattle to put what private brands they like or caste-marks on their cattle. I quite agree with you that caste-marks are useful, enabling one at once to distinguish between an animal which belongs to Punchirala and one which belongs to Puncha, and thus preventing false claims and disputes."

This saying is only too true. In a recent cattle-theft case in a police court, the real owner of the buffalo lost the animal, and the thief was decreed the owner, because the initial letters of the names of the village and the owner, exactly corresponded to those of the fortunate thief. But the distinctive "Caste Marks" were different. Though this was the best evidence in favour of the owner, yet the magistrate lost sight of the fact.

KANDYAN BRAND-MARKS.

Explanation of Plates.

Fig.
1. Sun and Moon (Chiefs) Matale
2. Stone (Dobies)
3. Manne, Knife, (Wahunpurayo) (Jaggery-caste Kandyans)
4. Half moon (Chiefs)
5. Daulkaduppuwa (Berawayo; tom-tom beaters)
6. Pahimbuwa (Three Korale Kandyans of rank)
7. Winnow (Oliyo; dancers)

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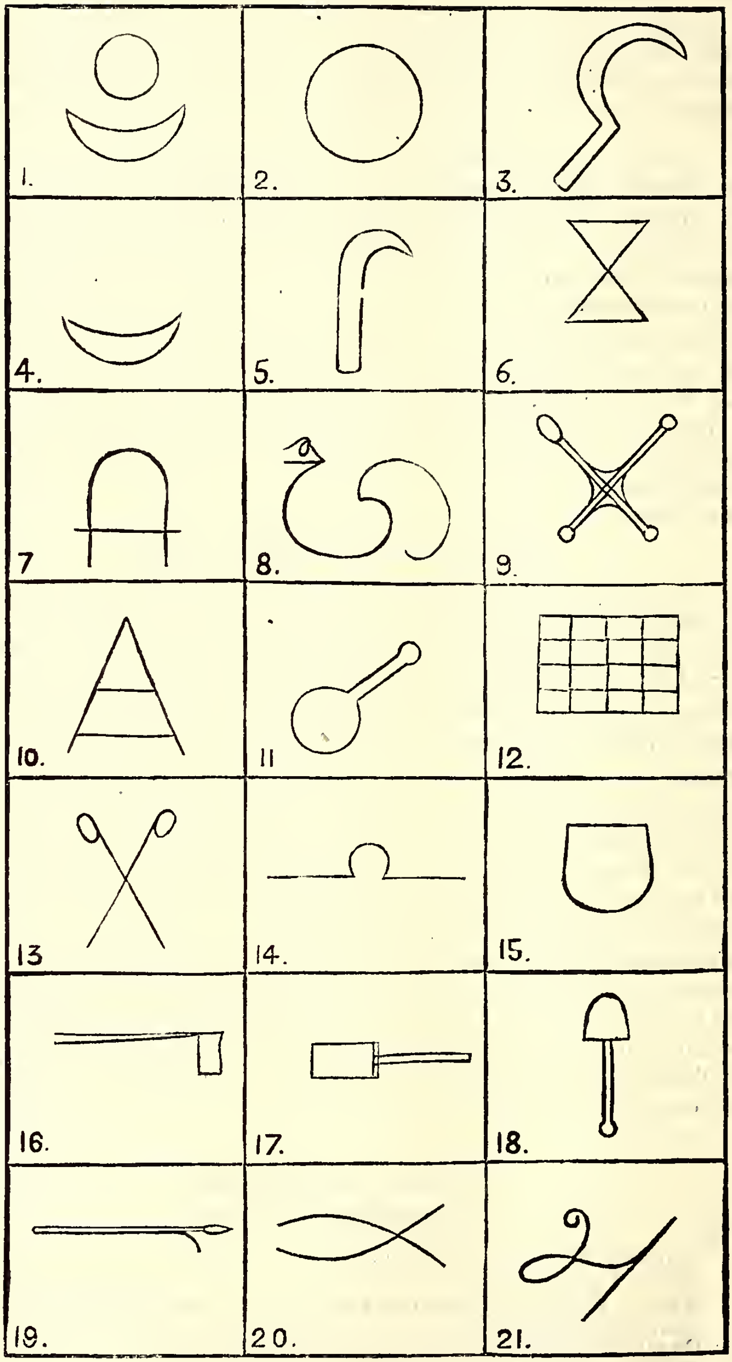
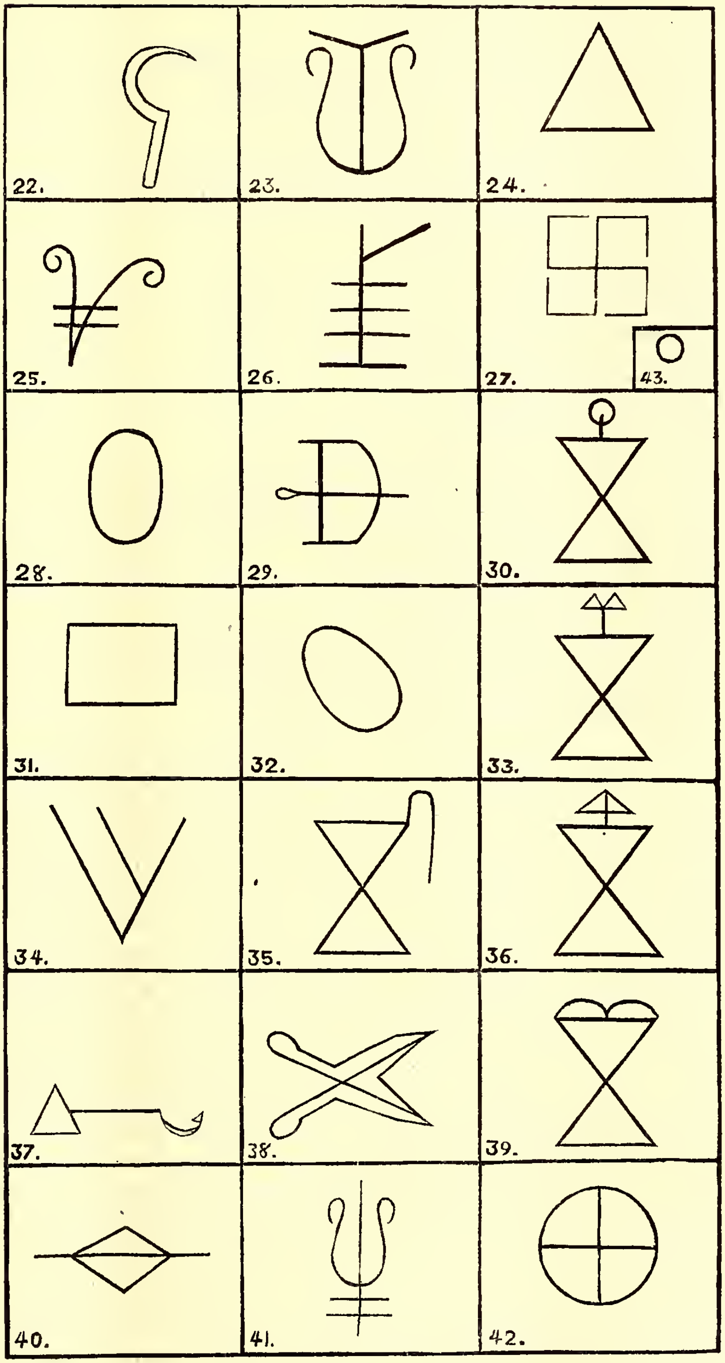
* For Kinigoda Korle the *Wahumhunudaluwa* and *Ada Handa*. For some low-country Sinhalese Gowigama people in Gangaboda Korle Galle District, I have seen the brand mark an ear of paddy, (*ViKarala*) on their cattle.



KANDYAN CATTLE BRAND MARKS.



KANDYAN CATTLE BRAND MARKS.

8. Letter Bhayanu (also for Berawayo)
9. Aduwa (Achari, Blacksmiths)
10. Jamajadiya (Kandyan moors of Kabatapitiya, Illawatura, &c.)
11. Betel-bag (Hannali; tailors)
12. Mat (Kinnaro; weavers)
13. Abrana-anduwa (Goldsmiths)
14. Krinanyate (Pattiwalayo, belonging to the royal palanquin department)
15. Batgam-alla (Paduvo); the palm of the hand
16. Porawa, axe, (Porokarayo; wood-cutters)
17. Walanpatta (Badahelayo; potters)
18. Hunupatta (Hunno; chunam-burners)
19. Henduwa, Etwalayo (Elephant-keepers)
20. Irattipure (Kegalle District Gowigama Kandyans)
21. Tamil letter A for Angammana, Gampola
22. Sickle (Pannayo) grass-cutters
23. Sulama (Devale villagers)
24. Kota (Kotmalie)
25. Jamajadiya (Four korale Kandyan Moors)
26. Tanirohotiya (Galbode korale)
27. Mediyama (Aluwihare, &c. Matale)
28. Bera-etie (also for Berawayo)
29. Dunna, bow, (Veddhas)
30. Bopata-Pahimbuwa (Dolosbage)
31. Kanda, Log of wood) Paliyo
32. Waramanda (Rodiyas) rope made of hide
33. Irattinelunmal Pahimbuwa (Naranwita, &c.)
34. Kerallama (Unambuwa, Kirinda, Udowite villages)
35. Kokuwan Pahimbuwa (Gowigama Kandyans, some parts of Matale)
36. Nelun-mal-pahimbuwa (Gampola)
37. Agul-Tattuwa (Vihare villages)
38. Scissors, Embattayo (Barbers)
39. Torana Pahimbuwa (Dorakumbure village, &c.)
40. Ematikaiya (some Pattiwala Kandyans of Matale)
41. Jamajadiya Keerapone Kandyan-moors)
42. Wahunkuludaluwa (some parts of Kegalle)
43. Pata Bulatgama, the Binduwa, a drop.

A SUCCESSFUL CURE FOR TICKS IN CATTLE.

As the result of a brief statement recently made public by the Department of Agriculture (United States) concerning the use of crude Beaumont petroleum as a dip for cattle, especially those infected with Texas fever, a great many communications have been received, both from oil men and from stock raisers, inquiring as to the character of the oil and the method of its utilization for dipping purposes. A bulletin has, therefore, been prepared describing the treatment of Texas fever and the manner of using Beaumont oil for this purpose. The department says in part:—

"Many efforts have been made to discover a practical method for dipping cattle to destroy ticks without injury to the cattle, and the bureau has experimented for years with this object in view. Numerous kinds of dips have been used and many failures have been recorded, but apparently a successful one has been found in the crude oil—so called Beaumont oil—obtained from certain Texas wells. This oil has now been used on a rather large scale, and it has been very successful in killing ticks, without at the same time materially affecting the health of the cattle, when the proper precautions have been observed. In fact, it is distinctly superior to any of the other dips that have been tested. In these experiments it was found that a light oil heavily charged with sulphur is the most desirable for dipping cattle, as the heavy oils injure the animals dipped in them. An oil with 40 per cent. of its bulk capable of boiling between 200 degrees and 300 degrees C., having a specific gravity between 22½ degrees and 24½ degrees Beaume, and containing 1¼ to 1½ per cent. of sulphur is most desirable, and these requirements should be stipulated before purchase. In a recent dipping of 57,000 head of cattle on the Kansas and Osage Indian reservations, the results were very highly satisfactory, both as regards the

eradication of the cattle tick and the after results of the dipping, since the loss from all causes was less than 0·75 per cent. This loss represented in dollars and cents would amount to a very small portion (about one-twelfth) of the loss incurred by the sale of these animals as 'ticky' cattle in the stock yards of the North. Other cattle dipped in the same oil, but under conditions that cannot be considered parallel, suffered more severely. In order to obtain the best results, the animals, after dipping, should not be unduly exposed to the hot sun nor driven any considerable distance, but should receive plenty of food and good water. They should be allowed to stand for four or more days after dipping and prior to shipment. Dipping should not be attempted until after they shall have shed their winter coats, as a large percentage of all cattle dipped before the heavy coat is lost suffer from a severe irritation of the skin.

"The method usually adopted in dipping cattle is to construct a narrow swimming tank with a chute at one end for the entrance of the cattle and a sloping exit at the other end where the cattle emerge after getting a uniform coating of oil in passing through the vat. A drip chute or floor is connected with the exit where the excess of oil is allowed to drip off the animals and to drain into the vat. Plans and specifications for installing a dipping plant suitable for either small farms or large ranges are published in Farmers' Bulletin No. 152, which may be obtained from this department. It is relatively more expensive to dip cattle in the South where the farms and plantations contain a small number of cattle than in the range country of the southwest, where this method of eradicating ticks becomes not only plausible and practicable, but also economical. When cattle have been properly dipped in Beaumont crude petroleum or any other approved petroleum under the supervision of a veterinary inspector, and by him found free of infection, they may be shipped to any point above the quarantine line subject only to such restrictions as may be imposed at the point of destination. Such cattle must be shipped in clean, disinfected cars, and must not be driven through the quarantined area or be unloaded therein, except at those points designated by the Secretary of Agriculture. It is earnestly recommended that such shipments shall not occur earlier than four to eight days after the dipping is performed.

"Greasing the legs and sides of cattle with cottonseed oil, fish oil, or Beaumont crude petroleum will assist in preventing the ticks from crawling up on the body. In small herds, smearing the cattle with a mixture of one gallon of kerosene, one gallon of cottonseed oil and one pound of sulphur, or with a mixture composed of equal parts of cottonseed oil and crude petroleum, or with Beaumont crude oil alone, has proved efficacious when applied to the skin two or three times weekly during the tick season. For this purpose sponges, syringes, brushes, mops, or brooms may be used. This method not only kills the older ticks on the cattle by mechanically plugging up their breathing pores, but also makes the legs so slippery, that the seed ticks are unable to get a foothold in order to crawl up on the cattle.

"Where a large number of animals are to be treated, but not sufficient to make it advisable to construct a dipping vat, spraying the infested animals has given very favorable results. The animals should be placed in a chute or a stall or tied to a tree, and then sprayed with Beaumont oil or a 5 per cent. solution of any of the standard coal tar dips. The solution may be applied by means of a force pump, such as is used by orchardists to spray fruit trees, or by placing the solution in a barrel upon a wagon or on a platform above the animals, and allowing the fluid to gravitate through a hose, to the end of which is attached an ordinary sprinkling nozzle. The solution is then allowed to flow over the skin of the animal, especially upon the legs and under portions of the body. If the cattle are on tick-infested pastures, this treatment—either smearing or spraying—must be continued through the whole season, and if thoroughly done it will leave the fields free from ticks the following year."—*Oil Reporter (New York.)*

Correspondence.

RUBBER TAPPING METHODS.

A COMPARISON OF THE SPIRAL, HALF-SPIRAL, AND HERRING-BONE METHODS.

Sir,—"One cannot have omelettes without breaking eggs." There is an egg that wants breaking badly; and I trust the omelette will not prove indigestible! I refer to the mystery which enshrouds the question of "The Unit of Bark to Yield of Rubber."

Many rubber planters, even among those who no longer hold the crude idea that full spiral tapping, even when carefully done, is a species of ringing the tree, still hesitate to adopt this method, obviously the easiest and cheapest of the three, because the *dictum* has gone forth, with good authority, that the Peradeniya and Henaratgoda experiments prove that the greatest yield per unit of bark excised has been given by the herring-bone system, though the greatest yield per tree has been given by the full spiral. They, therefore, imagine that there is a *desideratum* in herring-bone tapping, in spite of all its disabilities of left, as well as right, hand cutting, of many drip-tins or expensive manual application of water to the various cuts, and of untappable areas which is not to be found in spiral tapping; and that while prices rule high, the extra expense of these disabilities will be more than covered by the bark lasting longer.

It is my purpose to show where the fallacy has crept in, unavoidable and accidental though it be.

As it is an accepted fact that the latex cells lie in series in the line of the stem, and that the greater and freer drainage and inter-drainage of these series of cells takes place in that line, it follows that many more cells will be drained by a cut across that line than by one in its length; in effect that a level cut across the bark gives the greatest possible yield of latex and the perpendicular cut the least—the cuts being of equal length. We also know that these cells, after drainage, have the power of sealing themselves up and again becoming full of latex in about two days, when a thin paring cut will re-open them and give another full flow; and so on while the bark lasts. Now, in the case of the perpendicular cut a whole series of cells is entirely removed which would otherwise have filled up again with latex; whereas in the level cut only the ends of the series are removed, and the same area of cells is drained over and over again. It, therefore, follows that:—(1) the *nearer the level* the cut is made, the greater the yield and the less the excision of bark; (2) the *nearer the perpendicular* the less the flow and the greater the excision of bark. And since we have the choice of any angle between level and perpendicular, or zero and 90°, it follows that the man who taps at an angle of 75°, 80° or 85°, is little better off in yield and loss of bark than the man who taps perpendicularly. While he who taps at 20°, 15°, or 10°, has nearly as good a return as the level tapper. But these low angles suffer from the disability that latex will not run in channels on such gradients and so becomes scrap, which for cogent reasons does not suit the practical planter. He, therefore, sets about to find the lowest angle at which natural latex would flow, and by some strange fate 45° was fixed on for the spiral method especially. (I suppose because it was so easily made by cutting a square sheet of tin diagonally across and using each half as a guide for his line on the tree.) But there it has stuck—at 45°! Even in the Botanic Gardens mentioned above, no other angle than 45° for the spiral has been used, to the best of my knowledge; and certainly no other angle on the various estates I have visited. For the herring-bone, on the other hand, both in the Botanic Gardens and on these estates, exceedingly flat angles have entirely been used, in some instances so flat and irregular that the latex had to be coaxed into the runnel by an attendant who could look after only a few trees at a time.

Those who have followed the argument will see that it is manifestly unfair to compare tapping done on flat angles with that at 45°, in which latter the channel has to be probably 25 per cent. longer, in order to cut across the same number of cells, and therefore, with greater waste of bark—the paring being the same in thickness in both cases. And it was just at this point, unavoidable though it may have been, that the flaw occurred and the deduction was wrongly drawn as to the merits of these two systems. Given the same angle, I maintain that the spiral will beat the herring-bone in yield per unit of bark excised; for it can easily tap all the basal portions of the tree, where the latex is in greater quantity and richness, which are only reached by the herring-bone and half-spiral with difficulty and inconvenience, owing to their peculiar construction.

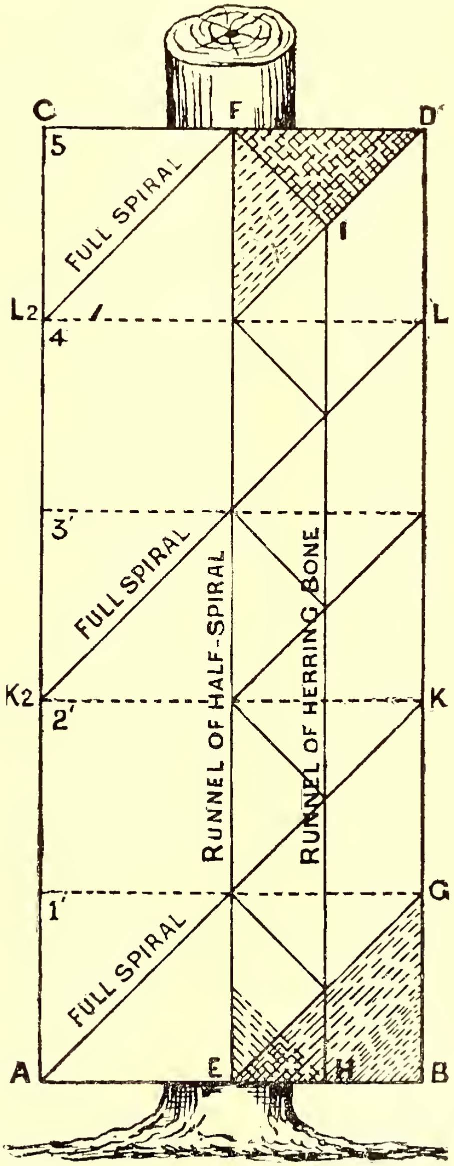
And with the advent of water flotation and the drip-tin especially—which is an unalloyed blessing in its prevention of scrap and of manual labour, watering the cuts—the necessity to tap at 45° for the spiral has disappeared, and a much smaller angle, say 30° or 35°, can be taken. This will be a matter for experiment to those interested.

At any rate, the day is passing away when the practical planter will tolerate the expenditure of attendants watering the cuts by hand when it can be done by mechanical means.

It stands to reason then that, at whatever angle a herring-bone can be cut for self-acting water flotation, at that angle also can the spiral be cut, and also the half-spiral which, however, exceeds the herring-bone in amount of untappable and inconveniently tappable areas. These amount to, at least, one-fifth of the whole in the half-spiral and one-tenth of the whole in the herring-bone, as compared with what can be done on the spiral method within the reach of the average tapping cooly—that is, five feet.

Perhaps a sketch, which any one can easily make for himself, will not be out of place here. Let us take the case of a tree averaging 24 inches in girth (never mind the tapering shape, for it affects all three systems in the same way) the tapping area as five feet above the level of collecting vessel, and the spacing as one foot, and the scale as one inch to a foot.

Draw the line A. B. = two inches.



At A. erect A. C. and at B. erect B. D. pependiculars 5 inches. Join C. D. A. C. D. B. is the tapping area for the spiral.

Bisect A. B. at E. and raise perpendicular to F.; E. F. D. B. is the tapping area for half-spiral and herring-bone.

Divide these perpendiculars into foot lengths. From E. draw E. G. at 45°, to 1 foot above B., and parallel to this draw the rest of the lines from the 1 foot spacing points. These are the half-spiral channels, F. E. is the runnel. A glance shows that above the topmost channel is a triangle of untapped bark whose base is F. D., and below the lowest channel is a triangle whose cuts gradually run out, away from the runnel and disappear at B.

For the herring-bone bisect E. B. at H, run a perpendicular up till it meets the top channel at I. H. I. is the runnel. Join I. F. I. D. I. F. are the top channels. Parallel to I. F. from the one foot points draw the other four lines to the central runnel. At the top a triangle F. I. D. is left untapped, and it will be seen that, when the lowest channel reaches the foot of the runnel, two small triangles will be left, the cuts on which will gradually run out at E. and B.

Comparing these two systems, it will be seen that—with its disability of loss of tapping area—the half-spiral requires, after the cut has begun to run out at the bottom, only one extra spout and collecting cup to the herring-bone's extra two, and only five applications of water, or five drip-tins to the herring-bone's ten!

Even pretty Karrupaie, deftly watering the cuts from a sort of bitters-bottle and buzzing around from tree to tree in her little group of five or six trecs at a time, would prove far too expensive a luxury, however picturesque; so let us hasten to the spiral.

For the spiral: from A. draw A. K. at 45°, *i.e.*, to the 2nd foot spacing above B. This line has completely encircled the tree, so go level across the figure from K. to its coinciding point K2, draw K2 L. at 45°, go across again to L2 and draw L2 Y. at 45°. The spiral has reached the top of the tapping area and encircled the tree two-and-a-half times, and as will be seen at a glance is of precisely the same length, viz., 84 inches (7 inches on the scale) as the sum of the lines in each of the other two systems. It requires *one* drip tin, *one* spout, and *one* collecting vessel; cut after cut will be the same all round the tree, there is no untapped or untappable area. Nay, more than that; it will reach further down any inequality of root or base of the stem even where the others cannot go. Further, it is seen that the spacing is *two* feet, so that an intermediate channel could be put in, but this would finish the bark in half the time. But if—as seems to be the idea just now with the improvements of modern paring and pricking—one foot is held to be enough bark to go over, in the time it requires for the originally cut bark to have grown thick enough again, to cut a new channel in and start over again, its superiority is at once assured. The two spirals, being at all times on opposite sides of the tree, the yield is at each time, early or late, at any period, monsoon or fine, in any aspect, to the dark side or the open, *an average of the productivity of the tree* for the time being, which is more than can be said of the other two, or of "compass tapping."

All this is of spiral tapping on the angle of 45°. What of the lower tapping angles of 30° or 35° which are now available through the use of water, which will go a few more times round the tree and give a much larger yield? On suitably large trees, say 36 inches in average girth, they will enable the planter to tap a large and fertile area at the base of his tree, say only 3 ft. 6 in. or 4 ft. up, and then with a *low* platform to tap a second story, the top of which need only be 8 ft. up, if *this procedure is found to be necessary*, which some men maintain is the case.

I do not pose, Sir, as an authority on these matters, but merely make an appeal to practical common-sense, on the facts regarding these three systems of tapping, which are available to us at the present moment.

If I am wrong at any point, I hope to be corrected.

Yours, &c.,

ALEX. CAMERON.

[The full spiral leaves L. F. C. untapped. We do not know that the cells can seal themselves up after tapping; it would be a most remarkable fact if they did. The latex accumulates in other cells near by. The whole question of the best way to tap is as yet in its infancy, and will probably be made the subject of careful research in the Botanic Gardens during the next year.—Ed.]

TEA PLANTING INDUSTRY IN NATAL.

NOTES ON COFFEE, COTTON AND RUBBER.

Natal, July 7th.

Dear Sir,—Some time ago I addressed you, requesting you to obtain for me an expert opinion upon some samples of teas I sent you. This you very kindly got for me.

Messrs. Forbes & Walker, who were consulted, very kindly pointed out a peculiarity in the ferment, which they said was either an error in withering, or a peculiarity resulting from the soil. Since then I have been, in various ways, trying to overcome this fault and have, I believe, at last succeeded in producing a tea as nearly perfect as local conditions allow. I am now anxious to have samples of these teas tested by the same firm, and with this object send you a complete set by even mail with the anticipation that you will again be good enough to ask Messrs. Forbes & Walker to kindly report upon them and have the result published in the *Tropical Agriculturist.*

The samples are numbered and arranged as follows:—A. consisting of five samples, represent my better class of teas. B. is one of my ordinary pekoes. C. consists of four samples representing the highest grade manufactured by four of the leading Natal estates, whose names for obvious reasons I refrain from giving.

The teas A. and B. are made on this estate, the roller being employed is a Jackson's new "Rapid" with teak facing and the drier a "72" Venetian. Both these machines are in my opinion hard to beat, if they can be beaten at all.

It is a good long while since I have contributed in any way to your very interesting paper, the perusal of which affords me each month many pleasant hours. With the present and all-absorbing native trouble, trade is absolutely at a standstill here, and a depression such as has never been experienced is fast spreading over the entire Colony, making the outlook more and more gloomy. We all hope for better times, but they still seem as far off as ever.

Expansions in tea acreage, however, in spite of all this, are encouraging and one estate in my immediate neighbourhood comes into bearing next season; the factory is now under erection. The owners are a go-ahead lot, and, it is to be hoped, they will help to improve the deplorable name Natal has lately got for its coarse teas. The Manager has had a year or two's training in India and Ceylon in tea, and with experience of local conditions as well, he ought to be in a position to add his charge to the list of very few places where quality is studied.

Coffee in Natal.—I am experimenting with a small patch of coffee. Coffee was tried years ago on rather a large scale, and for a while paid well. Then the dreaded *Hemileia vastatrix* appeared and the industry collapsed altogether, and,

so far as I know, no real effort was made to fight it. The style of cultivation was extremely crude. Trees were just left to grow up—like Indian and Ceylon "native coffee"—and no attention, save an occasional weeding or manuring given; while a pruning knife was an unknown factor. The trees, naturally weakened with neglect, soon succumbed to disease.

When I took charge of this estate, there existed a small area originally planted with coffee, but entirely submerged in scrub. Anxious to prove for myself the questionable unsuitableness of the country for coffee, I had the field cleaned up, and all the existing trees some over 20 feet high cut level with the ground. I then grew from each stem a single sucker which I topped at 4 feet, and put the field under artificial shade (*Grevillea robusta*). The coffee I carefully pruned and handled each year, and manured once with cattle and stable manure. The result has quite overstepped all expectations, and this season, in spite of very scanty rainfall, I have gathered 15 cwt. per acre. The trees have just been pruned, and although showing slight traces of leaf disease, for this time of the year (the middle of our winter) are remarkably healthy and carry fine red wood. I am very sanguine about it, and am pretty certain, if coffee is grown as it ought to be, it will not be the failure it is generally called.

To give you a fair idea of how things are conducted here, the following would not be out of place. A farmer in the Colony, who shall be nameless, thought, after his coffee had not yielded for 2 or 3 years, he would try pruning, and his method was to cut away one side of the tree clean to the stem, including primaries, the other side being subjected to the operation the following year. Needles to add, the field is now extinct!

COTTON promises to be a future industry here. Two years ago a syndicate was formed to test the practicability of growing cotton on paying lines, and Mr. John Kirkman (of Bever-stove-Equeefa), an old and experienced colonist undertook the management. He has proved beyond the experimental stage that the industry well repays itself, and prices he has obtained are highly encouraging. The seed used was mainly Sea Island and also a good deal of German East African, the fibre produced being of intense whiteness and a very long staple.

RUBBER IN NATAL.—Some correspondence appeared in the local newspapers as to Natal being suitable for rubber—one gentleman, from Ceylon I believe, being quite emphatic as to its being made a paying industry. He must have been a newcomer evidently, for the insufficient rainfall is in itself an insurmountable obstacle, and rubber can never be made to produce a yield that will be profitable. It *grows* here well enough, as evinced by some trees I have on the place of the Para variety planted by a former owner, but there is little or no sap in the trees. We have also a wild rubber, producing a gum of very superior quality. Here again the quantities that can be got are so little, that with the expensive labour we have to employ here, it would not pay to try to collect it.

Ceylon seems to have gone crazy on rubber-growing, and from all accounts in the "*T.A.*" the industry seems to be highly remunerative. It is amusing what a little time ago was almost exclusively a tea paper, deals now with rubber, and almost nothing but rubber!

I hope to hear from you in due course and, when I can, I shall not forget to write again.

Yours faithfully,

W. A. GILBERT.

[Somewhat over a year ago Mr. W. A. Gilbert sent us some samples of his teas which Messrs. Forbes & Walker kindly reported on for us. This firm has again given us their opinion on his teas, and this time it is a much improved report

that they are able to make. The Natal teas from Mr. Gilbert's estate are excellently made and finished; that is the A. samples. The B. samples are not nearly as good, some of them being little better than rubbish. The flavour of the teas is much like China tea, but in appearance the A. samples resemble Cachar teas. We append Messrs. Forbes & Walker's report, for which we thank them; and we congratulate Mr. Gilbert on his progress in spite of the difficulties to be contended with in a country like Natal.—Ed.]

REPORT ON SAMPLES OF NATAL TEAS.

(*A*) *Samples 1—5* representing Broken Orange Pekoe, Broken Pekoe, Pekoe No. 1, Pekoe No. 7, and Pekoe Souchong.

These samples in appearance are satisfactory, being well made, clean and well graded. The liquors are plain with fair quality and strength. The infusions are somewhat dull.

(*B*) *Sample.*—This is Broken Pekoe of fair appearance and tips. The liquor is the same character as "A" but of inferior quality.

(*B*) *Samples 1—4.*—These are all flaky broken teas rather stalky and reddish. The liquors are common and unattractive. Infusions are dark.

"A" Samples are useful teas and might be described as ordinary, fair medium teas.

"B" Sample is a common to medium tea.

"C" Samples would rank amongst common China red leaf siftings.

(Signed) Forbes & Walker.

RUBBER GROWING.

Dear Sir,—I am interested in a rubber proposition, in a country which has not yet reached the stage of production on a large scale, though trees have been sucessfully grown experimentally and on a small scale, and I shall be much indebted if you will be good enough to give me the benefit of your views on the following points, viz:—

(1.) What is the lowest rainfall necessary for the successful cultivation of rubber, on land which is not periodically flooded, as for instance some of the Brazilian forests?

(2.) Is a planter, with general and wide experience in the cultivation of tropical plants but with none as to rubber, likely to be successful in growing it, with Herbert Wright's book as his main guide, supplemented by such information as he can gather from planters in his country, who may or may not have had actual experience of the successful production of rubber?

Yours faithfully,

T. S. TURNBULL.

Manchester, 3rd August, 1906.

[(1) If this refers to Para rubber, we should say the lowest rainfall is usually from 65 to 75 inches, well distributed. The tree will not stand long droughts.

(2.) It depends on the plants. Rubber cultivation is as yet so absolutely in its infancy, and we know so little about methods of tapping, yield, &c., that any man with common sense and adaptability should be able to get on well enough with it. Mr. Wright's book will give him most of what is already known upon the subject, but probably within 5 years will be hopelessly out-of-date.—Ed.]

FEBRIFUGE PLANTS.

SIR,—With reference to the enquiry by your correspondent—Mr. G. E. Weerakoon—in your issue for July, 1906, p. 113, I have the pleasure to inform him through the medium of your esteemed journal as follows:—

I would premise by calling Mr. Weerakoon's attention to the well-known aphorism that where the identification of a plant is concerned, it is quite unsafe to entirely rely upon its vernacular names, as it is not seldom the case, that in India one and the same vernacular name is applied to more than one plant. In this connection, for example, we have both *Andrographis paniculata*, Nees., and *Swertia chirata*, Ham., called by the same Sanskrit name *Chunimba.*

Your correspondent by the said vernacular name *(Chu-nimba)* presumably refers to *Andrographis paniculata*—which is a shrub of the Natural order Acanthaceæ, very bitter in taste, and used not only as a febrifuge, but also as a stomachic, tonic, alterative, &c. It is well-known in Bengal as a very useful medicine for infants to remove constipation, bring appetite and to help the liver to perform its functions. Whereas *Cephœlis Ipecacuanha*, Rich., which your correspondent seems to have confused with *Andrographis paniculata*, belongs to the Natural order Rubiaceæ, the roots of which yield medicines used as an emetic, expectorant, diaphoretic, alterative, &c.

There is no vernacular name for *Cephœlis Ipecacuanha* known to me, which could even approximately serve as a guide to Mr. Weerakoon in identifying the plant. However, I think I cannot do better than refer your correspondent to Hooker's Flora of British India, Vol. III., p. 178, for the description of the plant.

Yours faithfully,

K. BANERJEE.

Office of the Director of Agriculture, Punjab,
Lahore, India.

16th August, 1906.

LEMONGRASS OIL EXTRACTION.

DEAR SIR,—I shall be glad to have the benefit of your advice as to the extraction of Lemongrass oil. I have, no doubt, derived much useful knowledge on the subject from the back issues of the *Tropical Agriculturist;* but I am sorry to say that the extraction of the oil by aqueous distillation in copper stills has not been properly understood by me.

A detailed account of the copper still, and the method of extraction thereby, will greatly oblige.

Yours faithfully,

A. PAUDE.

Zeyawadi, Burma, August 12th, 1906.

[A Circular will very shortly be published from the Botanic Gardens on this subject.—ED.]

ADHATODA VASICA AS A GREEN MANURE.

DEAR SIR,—On a recent visit to the North I was greatly struck with the value placed by cultivators on *Adhatoda vasica* as a green manure for tobacco, onions, etc. A man's load fetches 75 cents and upwards, and the plants, which (as its Tamil name "Adathodai" implies) 'goats will not touch,' are carefully conserved for fertilizing purposes.

Adhatoda is a very common weed in the Western Province, but so far as I am aware its value as a manure is not appreciated by cultivators there. The use of the leaves for green manure is not confined to Ceylon, for the practice is pretty common in India. It may be mentioned that in India the plant is as much used for fertilizing as for its property of destroying aquatic weeds, such as *Lemnae* in flooded rice-fields. Mr. Hooper of the Indian Museum, who has made a number of analyses of Adhatoda, is of opinion that they fully bear out the high reputation in which the plant is held, containing as it does from 3 to 4% of Nitrogen, and considers it a most valuable fertilizer when ploughed or forked into the soil.

Altogether *Adhatoda vasica* is a most interesting plant, combining the properties of a fertilizer, medicine (both in human and veterinary practice), insecticide, poison (for fish and aquatic plants) and antiseptic ; but its most valuable property is undoubtedly as a fertilizer, supplying not only a high percentage of nitrogen, but also an appreciable amount of mineral matter. I would suggest that its properties as such should be brought prominently to the notice of native cultivators.

Yours truly,
C. DRIEBERG,
Superintendent of School Gardens.

Government Stock Garden,
Colombo, 31st August, 1906.

HONEY PRODUCTION IN EUROPE.

DEAR SIR,—The following paragraph will be of interest to apiarists, and might be published in the *Tropical Agriculturist.*

Yours faithfully,
W. H. M. DAVIES.

Colombo, 29th August, 1906.

"According to statistics in the Handel's Museum, Germany leads in the production of honey among European countries with 1,910,000 beehives, furnishing 20,000 tons of honey. Spain is next with 1,690,000 hives and 19,000 tons of honey. Austria-Hungary is third with 1,550,000 hives and 18,000 tons of honey. The other European States are far behind. France produces 10,000 tons, Holland 2,500, Belgium 2,000, Greece 1,400, Russia and Denmark 900 tons each. In these statistics the effect of climatic conditions is noteworthy, especially when comparing Russia and Greece. The latter has only 30,000 beehives, yielding 1,400 tons of honey, while the former with 110,000 hives, produces only 900 tons."

MOSQUITO NETTINGS AND MUSLINS.

DEAR SIR,—We beg to forward you a few samples of our Untearable Mosquito Nettings and Muslins, which, as they will stand indefinite washing without tearing, will, we believe, prove very valuable protection from malaria.

The "British Medical Journal" and the "Lancet" have already reported very favourably on them, and in view of the hygienic value of these fabrics, we trust you will think well to notice them in the columns of your valuable paper

Yours faithfully,
A. M. HART, LTD.

[These samples are wonderfully strong, but the threads are so stout that there cannot be good ventilation, especially in the finer one. How they compare in cost with cotton we are not told, and it must always be remembered that the people who are willing to give a good deal higher prices for better articles are but few.—ED.

MISCELLANEOUS.

AGRICULTURAL BANKS FOR CEYLON.

BY E. S. W. SENATHI-RAJAH.

"THE CREDIT FONCIER DE FRANCE."—The results obtained in Germany by the Land Banks (Landschaften) were first brought to the notice of the French Government by Monsieur Wolowski, one of the most eminent of French economists and financiers, in a luminous treatise which he published in 1835. Ten years afterwards, M. Royer, Inspector of Agriculture, was commissioned by the Government of France to repair to Germany and study the system of land banks which were then in operation there, and he made an elaborate report describing minutely the mechanism and operations of the chief landschaften, and the system of debentures which formed the pivot of the German land banks. The Government took the matter up in 1851, and an enquiry was held in which a number of distinguished financiers, economists, lawyers and officials were examined, and as a result of the enquiry a law was passed on the 28th of February, 1852, which laid the foundation of Land Credit Societies. In March, 1852, a powerful society was formed at Paris, another at Marseilles, and a third at Beners. It was, however, thought that a single society having branches in various parts of France would better command credit for its debentures than a number of small isolated societies. The three societies were therefore merged in one and received the name of "Credit Foncier de France," and received a monopoly for 25 years. Various errors were committed at first, but gradually by means of great prudence in administration, by steady payment of its dues to debenture-holders even in years of war and famine, and also by its connection with and supervision by Government, it obtained the confidence of the public. Its first heavy loan of eight million pounds in debentures was gradually taken up by the public. It rose steadily in public confidence, and in 1858 at the instance of Government it assumed the responsibility of issuing a loan of four million pounds for drainage works which the Government itself had previously attempted without success. At the instance of Government it established an affiliated society for the purpose of *credit agricole*, that is for granting short term loans without mortgage to farmers. In 1860 a new law authorised this new development and granted the Society a special guarantee. In the same year another law authorised it to grant loans to departments, communes and agricultural associations. Its privileges were also extended to the French Colony of Algeria. These extensions were all carried out at the instance of Government, and to meet the new liabilities its share capital was raised in 1870 to £3,600,000. The most remarkable proof of its stability was afforded by the terrible Franco-German war of 1880, which had no effect whatever on its credit, while the whole loss due to the depreciation of property at that critical period was only £160,000. Since the war of 1870, the Credit Foncier de France has attained enormous development in various directions, such as the extension of its business throughout various rural districts, formation of the Credit Foncier of Algeria, and the Compagnie Fonciere de France and Algeria, the latter of which was intended to facilitate works of improvement and construction. In 1878 it issued an enormous loan of £36,000,000. in mortgage debentures of £20, bearing interest at 3 %.

The success of the Credit Foncier was at first mistrusted by many in France. They said it was a novel experiment, not in consonance with the manners and customs of the people, or with the social or economic conditions of France. Errors were committed no doubt, but what ensured its success and popularity was the principle of sinking fund and land mortgage debentures, an

account of which will be given later on. The success of the Credit Foncier was so signal, that it was at once copied by Russia, Austria and Italy. Even Germany, which had furnished the original prototype, now founded associations in imitation of the French model. The Credit Foncier de France differs from the old German land banks (landschaften) in several important points. The Credit Foncier has a share capital, while the German banks had neither share capital nor dividends, but simply aimed at providing cheap loans by the united guarantee of the principal land-owners. The German banks have unlimited liability, while the Credit Foncier is a joint stock company with limited liability. In the German banks the debentures are secured by the mass of mortgages held by the bank and by the unlimited liability of all members, while the security of the Credit Foncier are the share capital and reserve. The loans of the Credit Foncier are given in cash, whereas the old landschaften granted the loan on debentures to the borrower. The landschaften banks are comparatively local, operating in moderate areas ; whereas the Credit Foncier is a vast centralised institution extending over the whole of France by means of agencies. The Credit Foncier acts in certain respects as an ordinary bank receiving deposits and employing part of its capital in short term loans. Loans are probably cheaper in the landschaften, since their credit is unlimited, no share capital to absorb profits as dividends, and all profits return to the members in the shape of cheap loans.

Most of the other countries of continental Europe have introduced agricultural and land banks founded on the model of the German landschaften or the French "Credit Foncier," or on a partial adaptation from each. A brief description of the Constitution and working of the land banks in continental Europe will be not without interest to us, particularly as the continental nations are governed as we are by highly bureaucratic methods, and they afford therefore apt models for our imitation.

ORIGIN.—Their origin in almost every instance is due to the impulse given by the state. The old landschaften of Prussia came into being by the fiat of Frederick the Great of Prussia, who wanted to give relief to his noble proprietors, who were crushed down by war and usury. He ordered that not merely all members of the bank, but every noble owning lands within the province where a (landschaften) bank was situated, should be wholly responsible for the operations of the bank. He also granted financial aid to the best five old landschaften in the form of subvention by the state, partly to supply the first instalment of funds and partly as a reserve against contingencies. Tzar Alexander of Russia gave all the funds necessary for starting the Land Credit Bank of Russia in 1818. The Credit Foncier de France, which is a joint stock company, received a subvention of £400,000 from the state in addition to a guarantee that the state and the district councils would purchase a quantity of its debentures, not only to provide the first funds necessary to set it afloat, but chiefly to create public confidence in its stability. So all the land banks of Europe without exception have come into being by the efforts of governments of their respective countries, and have been subsidized by such Governments and watched over by them with fostering care. The Government connection and support were found to be essential, inasmuch as banks, being institutions of credit, the advertisement to the public that the Government has an interest in the bank, believes in its usefulness and desires its success, acts as an incentive to the shareholders and establishes public confidence in the stability of the undertaking. There are, however, no land banks in Europe which are directly owned and managed by the state except in Russia and in some of the small German states and the cantons of Switzerland.

ADMINISTRATION.—When once the Banks had been started by the impulse given by the state, the governments of the different European states appear to have watched the growth of these institutions with jealous care, and to have had a large

control over them. The most striking feature in the administration of the landschaften is the manner in which all members, not merely office-bearers, are compelled to work almost gratuitously on behalf of the bank. Every member is bound to take office under penalties which may amount to the calling in of his loan or the sale of his estates, and against such decisions he has no appeal outside of the bank. The co-operative principle is carried out with rigorous uniformity, and this enables the landschaften to work at considerable distances from their centres without much cost or risk. The bank is considered a quasi-public institution, and its officers come therefore under the law relating to the discipline of public officials. The bank is placed under the general supervision of the Minister of Agriculture and the immediate and special supervision of a Royal Commissioner, who is appointed by the King of Prussia. The chairman and the two councillors of the bank are elected by the deputies of the four districts, but the election is subject to royal confirmation. In the Credit Foncier de France there is a Board of Directors elected by the general assembly, but three out of twenty of them must be public officers of finance. The Governor and sub-Governor are appointed by government, and are removable only by the government. The Governor has great power and responsibility and is the executive head of the bank. In all the other land banks of continental Europe the state has in every instance assumed powers of supervision direct or indirect.

PRIVILEGES.—With the strict supervision exercised by the Governments of Europe, the land banks also have certain privileges granted to them. The Credit Foncier, for instance, has the privilege of using the government treasuries for the receipt of its dues and the deposit of its surplus funds. It enjoys a reduction of stamp duties in registration and the transfer of its debentures. Its debentures are payable to the holder, and the Courts cannot take cognizance of any claim by a third party unless the bonds have been lost or stolen. Trust moneys and public funds may be invested in the debentures of the Bank. It has a special and summary procedure for the recovery of its dues. The mortgaged property can be speedily attached by order summarily obtained from the local court. Its mortgages have precedence over all others except those of the state. The government at the start gave it a monopoly over the whole of France for 25 years from 1852, that is to say, no other Society was entitled to carry on business under this special law till after 1877.

The German landschaften have also various privileges, especially in the matter of the prompt recovery of their debts. Attachment of property of defaulters is prompt, and movables may be distrained in the first instance. This may be done by the bank's own agent or by demand of process from the local court through its bailiff, and the court is bound to issue process accordingly. In East Prussia and Silesia it is expressly provided that the banks may collect its dues on mortgages by any coercive process open to them without any proceedings in court, including distraint of movables, and attachment of debts due to the defaulters by third parties and attachment and management of the mortgaged estate.

(To be continued.)

Notes on Methods of Irrigation in Arizona.

BY J. H. W. PARK.

Although a good deal has been written concerning irrigation in the Magazine of the Agricultural Society, nothing so far has appeared to indicate that better methods of Irrigation than those now practised in Ceylon exist elsewhere. As the writer believes that with proper methods of distribution of the water from Irrigation Works and proper use of the distributed water in the fields, the areas cultivated in the Island might easily be doubled without any great extension of the works themselves, he trusts the following notes made in the course of a couple of years' residence near Phœnix, Arizona, in the United States, may be of interest. For the actual figures of results obtained he is indebted to the publications of the United States Department of Agriculture.

CLIMATE.—The driest zone of the United States is practically represented by the territory of Arizona. The average rainfall within the zone does not exceed ten inches per annum, and the rainfall at Phœnix, which lies almost in its centre, averages little over six inches per annum. The temperature is subject to extreme variations. Frost is not uncommon in December and January, and temperatures of between 100° F. and 120° F. in the shade are the rule rather than the exception in the summer months. Under such circumstances the evaporation is very great and averages close on 80 inches per annum, and excepting in bottom lands near the streams or for a brief season after rain, or where irrigation is practised, nothing except cactus and salt bush grows.

The accompanying diagrams show the rainfall, relative humidity, evaporation from a water surface and the mean temperature of Phœnix for each month of the year. For comparison the same factors for the driest district in Ceylon—Hambantota—are also shown. The evaporation from a water surface in Hambantota I have not been able to ascertain, but I give that for the district near Giant's Tank (as calculated by Mr. Parker) which probably is not very different from it.

The want of rain, dryness of the atmosphere and rate of evaporation all militate against the success of irrigation near Phœnix, but the variation in temperature makes a great diversification of crops possible. The soil is a gravelly loam underlaid by gravel and not specially retentive of moisture.

In spite of these apparently unfavourable conditions, the town has become the centre of a thriving agricultural district. This it owes to the waters of the salt river, a perennial stream which, taking its rise on the western slopes of the Southern Rockies, and fed partly by rain and more particularly by melted snow, flows close to the town and joins the Gila River on its way to the Rio Colorado and the Gulf of California a few miles below it.

THE IRRIGATION WORKS.—The waters of the salt river are diverted above Phœnix, along both banks by a series of dams and canals, one of the chief of which the "salt river canal" runs directly through the heart of the town. During summer the bed of the river is entirely dry, the whole of the water being taken for irrigation by the canals above, but below the town the river begins again with the surplus water from the farms, and this is again diverted by other canals and used for the production of further crops. The engineering features of these works do not call for any special remark; they are more or less of the type used elsewhere, modified by American ingenuity to suit their surroundings. The capacity of the works, the methods by which the water is distributed to the various users, and the means by which the channels are maintained are of more interest.

As much as 1,250 cu. secs have been diverted into the various canals during the month of March, when the flow is usually most plentiful, and the supply fell as low as 120 cu. secs in the month of July, 1900, during the whole of which year, one of unusual drought, it did not average more than 400 cu. secs. In spite of this deficiency no less than 113,000 acres of crops were raised in that year, while the greatest area irrigable may be taken as 150,000 acres. The actual quantity of water used per acre of crops was 2·78 acre feet in 1902 (including canal losses and rainfall), while the amount usually taken is between 3 and 4 acre feet per acre of crops raised. These figures may be compared with the consumption per acre of not less than 12·75 acre feet (not including rainfall) used under the Walawe Channels near Hambantota in 1904.

The water from the salt river is distributed to each of the main channels according to priority of right, the oldest channel being entitled to full supply while it is available, and the most recently constructed channel being the first to be deprived of water in times of tight supply. The actual quantity of water distributed to each of the various main channels is apportioned from day to day by a Commissioner specially appointed, and the quantity so apportioned is taken charge of below the gauge at the head of each canal by the various canal officers who attend to its further distribution.

The water is distributed from the main canals to the various users in proportion to the "water tight" or share of it actually owned by the user. In some cases the shares carry priority of right, but as a broad rule they entitle the holder to a certain proportion of the water only.

The actual division of the water from the main channels is effected by smaller channels known as laterals, near the beginning of which there is—sometimes at least—a gauge for the measurement of the water. Where these laterals supply the land of one owner they are constructed and maintained by the owner. Where they supply several owners they may have been constructed and maintained by the canal company, but are more generally constructed and maintained by the several owners in common.

Each owner is assessed for the maintenance of that portion of the main canal above his head gate only, and to this has to be added his share of the maintenance of his lateral if he owns it in common with others, or if it was constructed by the canal company. As a result of these arrangements the actual cost of water is greater near the tail than at the head of a canal.

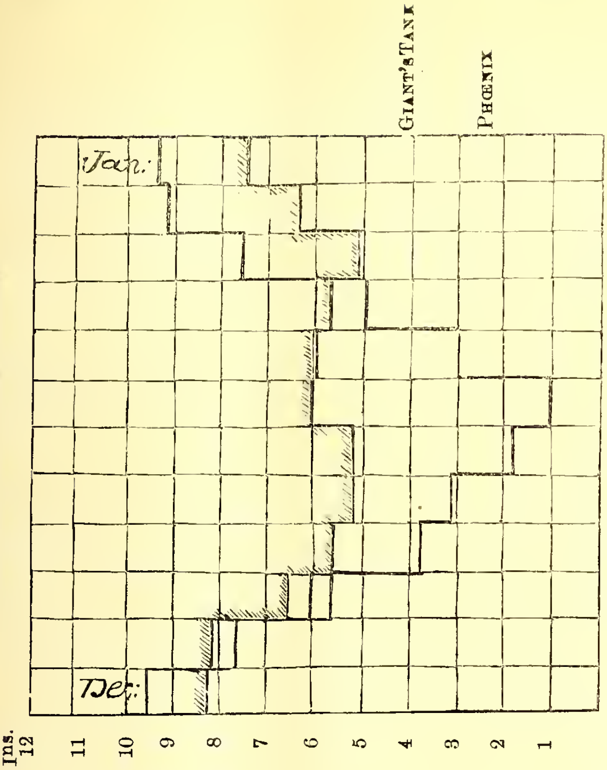
Recently the plan has been adopted of discharging the full supply of the main canal, or a definite proportion of it, into each lateral for a definite period of time. Where the lateral is the property of several parties the further distribution of the water is left to the parties themselves.

As an example of this method a certain farmer was entitled to all the water passed into the lateral from which he obtained his supply for 60 hours from 6 p.m. on each of the following days:—15th and 26th July, 6th, 17th and 28th August, 8th, 19th, and 30th September, 11th and 22nd October. The area irrigated was 50 acres, and from the figures he got water for 2½ days out of every eleven.

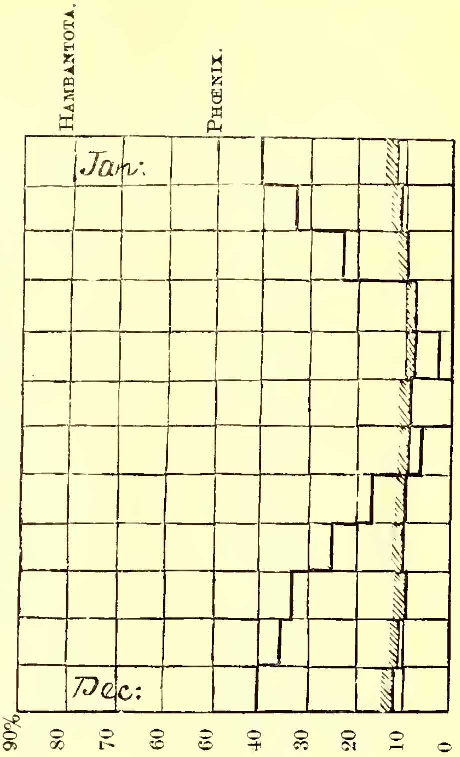
METHOD OF IRRIGATION.—Now with regard to the actual distribution of the water in the fields themselves. It is here that excessive waste of water takes place in all irrigation systems, and it is just here that the system in use round Phœnix appears to be most efficient.

From his lateral, or from another smaller lateral, if he holds his main lateral in common with others, the farmer distributes the water to his fields by a system of field laterals or small ditches taking off from the larger lateral more or less at right angles to it at distances of from 75 to 150 feet apart in grain and 150 to 200 feet apart in pasture land. These field laterals are frequently set off with an Engineer's level to a gradient of from ½ to 1½ inches per rood, or say from 1 in 300 to 1 in 100.

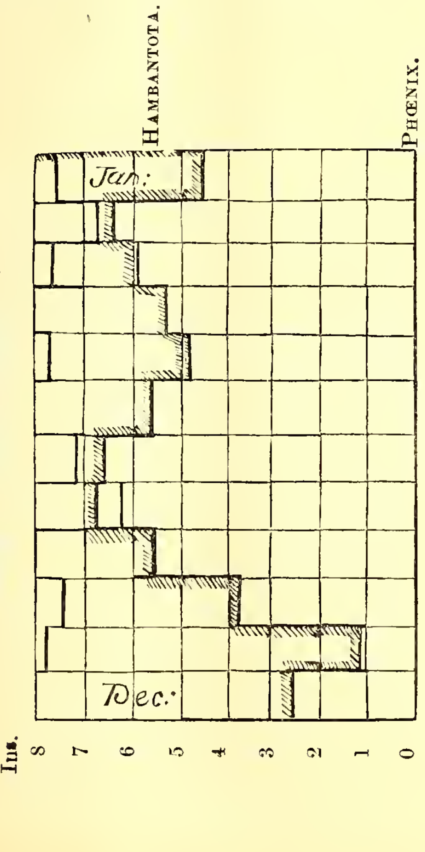
EVAPORATION FROM WATER SURFACE.



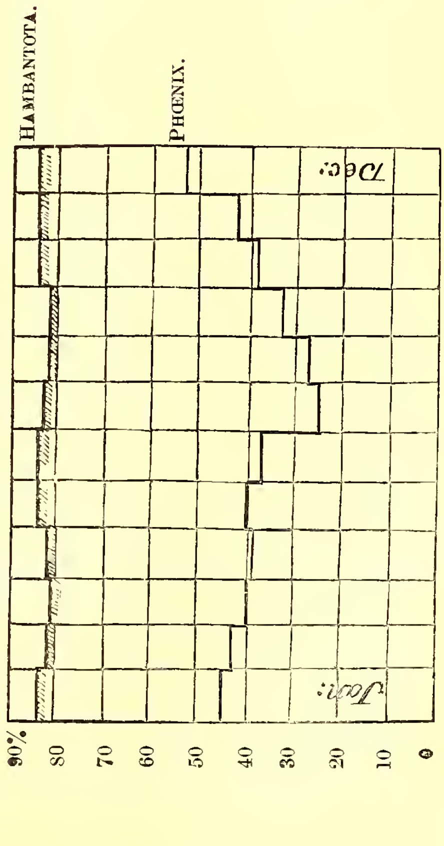
AVERAGE MEAN MONTHLY TEMPERATURE



MEAN ANNUAL RAINFALL.



MEAN RELATIVE HUMIDITY



From the field laterals there diverges a system of parallel furrows on the areas between which crops are grown. These furrows are generally from 6 to 9 nches in depth, while the distance between them varies from twenty-four inches to as many feet according to the crops to be watered. The length and gradient of the furrow varies with the distance apart of the field laterals, and to some extent with the soil, the object being to cause all the water in the furrow to sink into the soil and to allow none to escape. If the furrow is too short and too steep water will flow away and be lost; if on the other hand it is too long and flat it will be absorbed before the end is reached and part of the land will remain unwatered. The best length and gradient is found by experiment, and where the actual fall on the land is excessive, the furrows run at an angle to the greatest slope so as to reduce the gradient on them.

The depth of the furrow is also a matter of experiment, but the tendency during recent years has been to increase the depth, as by so doing the area through which soakage into the ground takes place is increased and the risk of flooding the land between the furrows is diminished.

The water is diverted from the field lateral to the furrows by damming the former with earth below the mouth of the furrow, but more recently the plan has been adopted of inserting small pipes varying from ¾″ diameter to about 2″ diameter through the side of the field lateral into the furrow, as by so doing a more regular distribution of water is obtained.

Flow from the lateral to the furrow is permitted for a period of time varying with the crops to be watered and the supply available, but in all cases after the flow has ceased and after the water has sunk into the ground; but before the surface has become entirely dry, the surface soil in the furrow is cultivated, that is the top to a depth of two or three inches is turned over. By this means the capillary tubes by which the water passed into the soil are broken up and the re-evaporation of water through them is prevented.

(To be continued.)

Mosquitoes and Anti-Malaria Campaigns.

The following letter from the "London Times" is worthy of attention in Ceylon, as showing the results of conscientious work directed against the propagation of Malaria by mosquitoes. Nothing of the kind has so far been attempted in the Island, chiefly owing to a feeling of helplessness in a country where the possible breeding places of the Anopheline mosquitoes are so multifarious. But with the example of work successfully accomplished at Klang and Port Swettenham, under circumstances comparable with those prevailing in Ceylon, we have—as pointed out by Dr. Ronald Ross—no excuse for neglecting similar measures here. At any rate, until the attempt has been made and failed we have no right to complain of the mortality and widespread sickness credited to this disease (malarial fever). Even should these measures fail in some of the wetter districts, the country along the Northern line—notorious for the prevalence of malaria—would lend itself more hopefully to successful treatment.

It must be remembered that infection is principally carried by mosquitoes bred in the immediate vicinity of any settlement, so that, to greatly reduce the danger of infection, it is not essential to operate upon a large tract of country. Each breeding place that is suppressed or rendered harmless will have an appreciable effect in the reduction of the disease.

E. ERNEST GREEN.

Campaigns Against Malaria.

Sir,—On several occasions you have kindly permitted me to draw the attention of your readers to the progress of the anti-malaria campaigns at Ismailia and in the Federated Malay States, and I have heard that the information so given has more than once encouraged the commencement of similar work elsewhere. Will you allow me to add some further notes? I hope it will not be necessary to trouble you again on the matter, as the success of the campaigns referred to seems to be now completely assured.

With regard to Ismailia, I wish to call attention to a brief but effective official report just issued by the Suez Canal Company. It is entitled "Suppression du Paludisme à Ismailia," and can be obtained by writing to M. le Sécrétaire-Genéral, Compagnie Universelle du Canal Maritime de Suez, 9, Rue Charras, Paris. It gives the whole history of the campaign in the town, with an account of the expenses and of the results. Since 1903 no new case of malaria has been observed at Ismailia. The ordinary mosquitoes (by which is meant the Culicina) have disappeared, and all the inhabitants have been able to discontinue the use of mosquito nets. Although a few Anophelines enter the town from the environs during the autumn, they do so in very small numbers—so small as not to constitute any danger, as shown by the complete disappearance of the fever. Doubts have frequently been thrown on the reality of the success obtained by the Suez Canal Company, but I think that a perusal of this report will convince any impartial reader. It must be remembered that up to 2,000 cases of malaria used to occur annually in this town.

The work done at Klang and Port Swettenham in Selangor, Federated Malay States, will be set forth in a report by Dr. Travers, State Surgeon, Selangor, and Dr. Malcolm Watson, District Surgeon, Klang, which will appear in the *Journal of Tropical Medicine*, Messrs. Bale, Son, and Daniellson, July 1 next. In this report, also, details of the history of the campaign, of its cost, and of its success are given, and will prove no less convincing. The statistics for 1905 are even more favourable than those of 1902 and subsequent years, while the disease is, if anything, increased in the surrounding areas which have not been treated. Dr. Watson says in a letter to me:—

"The work has been an absolute success, infinitely more so than I ever imagined possible. . . . I hope for a decided diminution in the amount of malaria. The absolute sweeping away of the disease seems to come as a reproach to me for lack of faith. . . . I wonder how many Government officers are deterred from making and carrying out anti-malaria works because the work seems so enormous, because they feel they will never be able to make any appreciable improvement, and because they fear they may have failure cast back at them. If there are such, I wish they could take a lesson from Klang."

I do not think that Dr. Watson will object to my quoting these important passages.

People have said that the success at Ismailia was due to the arid nature of the country, but I am sure that the same thing cannot be said of such a climate as that of the Federated Malay States, and it is clear that such striking successes obtained in such diverse parts of the globe leave no excuse open for neglecting similar measures elsewhere.

We may, therefore, hope that a few years will see the general adoption of such measures. A great incentive to this will be the new Malaria Return which has been promised by the Colonial Office, in response to action taken by Major Seely, D.S.O., M.P., in Parliament, consequent upon representations by Mr. Hahneman Stuart of this city. This return will, I hope, give full details of the actual

work done against malaria every year in tropical colonies. If the India Office and the War Office order a similar return, matters ought speedily to be in full train for a general advance in this important direction.

I am, Sir, your Obedient Servant,

RONALD ROSS,

Professor of Tropical Medicine.

The Incorporated Liverpool School of Tropical Medicine, June 27.—London *Times*, July 6.

Literature of Economic Botany and Agriculture. VIII.

BY J. C. WILLIS.

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Lessons in Elementary Botany. IV.

BY J. C. WILLIS.

For those who wish to use a Flora, or list of the plants growing in a given country, with descriptions—the first step towards finding out all about them—it is necessary to give a few, at any rate, of the technical terms used in describing leaves, as upon these a good deal depends the discrimination of plants. Those who are not desirous of using a Flora—let us say Trimen's Flora of Ceylon—may omit these.

The few technical terms given here are sufficiently illustrated by the figures in the Plate issued last month, to which reference should be made.

Leaves are *inserted* upon the stem in various ways: they may be all at the base (*radical*) or *opposite, alternate,* or in *whorls.* A complete leaf is made up of *leaf base* (the swollen part adjoining the stem), stalk or *petiole,* and *blade* (or *lamina,* as it is called in some older books). To the base are often attached a pair of outgrowths or *stipules,* one on either side, sometimes green and leaf-like, sometimes represented by thorns, tendrils, scaly outgrowths, and so on.

The leaf may be *petiolate* (stalked) or *sessile* (not stalked), *stipulate* (with) *exstipulate* (without, stipules). The base or stalk may be *sheathing.* If the base of the leaf is continued in a leafy outgrowth down the side of the stem the leaf is *decurrent.*

Leaves may be *simple* (with one blade, as in tea or cacao) or *compound* (with more than one, as in many brambles, &c.), and if the latter, either *pinnate* (with leaflets arranged featherwise) or *palmate* (leaflets like the fingers of a hand).

Leaves in shape (taking the general outline, regardless of notches) may be *needle-shaped, linear,* *lanceolate* (about three or four times as long as broad, tapering mainly to tip), *ovate* (about $1\frac{1}{2}$ to 2 times as long as broad, tapering to tip (*cordate* (heart shaped), *kidney-shaped,* and so on. If the tapering is more towards the base, *i.e.,* if the stalk in the figures were at the right instead of the left, the leaves would be *ob-ovate, ob-cordate, &c.*

The tip of the leaf may be *acute* (sharp pointed), *obtuse* (blunt ended), *acuminate* (tapering in curves to a point; water runs easily off leaves of this kind, and a pronounced acuminate point is sometimes called a drip-tip). An apex like *a* (bottom right hand corner of plate) is called *mucronate,* like *b apiculate,* like *c retuse.*

As regards notching: an absolutely un-notched leaf is *entire*; if the edge of the leaf be divided not more than half way down, the leaf is termed -fid, if $\frac{1}{2}$ to *-partite,* if more than $\frac{3}{4}$, *-sect.* The prefixes *palmati-* or *pinnati-* are put before these terms to indicate which sort of notching occurs. If the leaves are simply notched to less than $\frac{1}{4}$ of the depth, other terms are used, indicated by the figures, viz., *serrate, dentate, crenate, undulate.*

The surface of the leaf may be *glabrous* (without any hairs), *downy* or *pubescent* (fine, soft hairs), *hairy* (coarser hairs), *hispid* (rough bristly hairs) *tomentose* (with a cottony felt of hairs), *prickly,* &c.

The texture of the leaf may be *thin, coriaceous* (leathery) *membranous, succulent,* &c.

Leaves may be *evergreen* or *deciduous* (falling), &c.

When a character comes between two of the terms used here, both are employed, *e.g., lanceolate-ovate.* When it is nearly like one, sub- is placed in front it, *e.g., subacute,*